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Educational Psychology

Educational Psychology

H. L. Hollingworth

Professor of Psychology in Barnard College,
Columbia University Author of *Mental
Growth and Decline, Psychology of
Functional Neuroses, The Psychology of Thought, etc.*

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316

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PREFACE

Textbooks of educational psychology fall into several categories. Those of one group are primarily introductions to elementary psychology for students chiefly interested in teaching. They survey the general topics of human psychology, illustrating them so far as possible by school examples. In a second group fall books devoted primarily to the psychology of the school subjects, elementary or secondary. These tend to be reports of educational experiments in the special fields of teaching or discussions of special methods. Books of a third group are closely restricted to educational themes but assume a general introductory knowledge of human psychology. The emphasis is on the application of psychological principles to educational problems, and a preliminary knowledge of psychological principles and terminology is taken for granted.

Choice between these methods should obviously be determined by the use to which the text is to be put. The present volume remains close to educational topics, after presenting in an untraditional way, in Part I, such general psychological principles as seem specifically to underlie the processes of teaching and learning. It would be an advantage if educational psychology could cease to be an assemblage of miscellaneous and unrelated topics, so that prospective teachers might come to view their work in at least as unified and systematic a way as the facts justify. The present text is written in the conviction that the human mind is really coherent; that the principles of learning and teaching are actually simple and capable of intelligible generalization, on the basis of observed facts.

It is believed that the main principles of cue reduction, scope or control, motivation, and individual differences reviewed in Part I are the fundamental ones for the teacher to know. The application of these principles to all aspects of education ought to assist in bringing the work of teaching and learning from a rule-of-thumb level to a plane inviting artistry and encouraging scientific analysis.

References to material used in the text are given as footnotes. Additional references, given for each chapter, are mainly the better known and more easily accessible ones, usually books. The exercises for each chapter are intended to serve as supplementary topics for class discussion, demonstration and thought. Useful bibliographies on similar educational topics, and an array of problems, cases, and questions for discussion will be found in Watson and Spence, *Problems in Education for Psychological Study* (The Macmillan Co., 1930). This volume or Whipple's *Problems in Educational Psychology* (Public School Publishing Co.) will be found useful as a supplementary syllabus in a course in which the present book is used as the basic text.

The author has found a useful plan for a three-hour weekly course to be one hour considering a chapter and the accompanying exercises; one hour devoted to a lecture expanding the topic or introducing supplementary material or considering another chapter; and one hour given in alternate weeks to (*a*) practical problems discussed in small groups after the method of a "staff meeting," and (*b*) demonstrations, brief experiments, or written tests and reviews. Special topics, collateral in character, investigated by class committees or reported by individual students, can easily be introduced also as a part of the third hour section. Another useful method is to substitute for the third hour a two-hour laboratory period in which experiments on learning, transfer, memory, mental measurement, individual differences, and motivation are developed by the technique common in experimental psychology.

H. L. H.

CONTENTS

PAGE

PREFACE v

PART I
PSYCHOLOGICAL FOUNDATIONS

CHAPTER

I. INTRODUCTION 3
  The aim of education 3
  Experience is the only teacher 3
  Education as an experimental venture 4
  Fields of education 5
  A brief glance forward 5

II. THE PSYCHOLOGY OF LEARNING 9
  The learning of lower animals 10
  Learning in infancy 12
  Learning before birth? . . . 15
  More advanced cases of learning (language) . . . 16
  Code learning (substitution test) . 18
  Learning to play the piano 21
  Learning to drive a motor car . 23
  The learning of more subtle acts (thoughts, feelings, attitudes) 25
  Discovery and learning 27
  A diagram of the learning process 30

III. CONTROL AND MENTAL BALANCE 35
  Control of the reflexes 35
  Control in familiar activities 36
  Docility and sagacity 39
  Variability in learning and scope 40
  Cases of faulty mental control 43
  Illusions, due to lack of control 44
  Lack of control in the neurotic 45
  Phenomena of transfer in learning 46
  Docility, sagacity, and intelligence 47
  Mental control in school activities 49
  Facilitation and interference 52
  A map for the analysis of mental control 53
  The basis of originality 56

IV. MOTIVATION—THE DYNAMICS OF EDUCATION . . . 59
  Stimuli as motives 59
  Motives are always irritants 60

CHAPTER PAGE

Motives or drives *vs.* incentives or cues 62
Motives originating in the individual 64
Coöperation of drives and incentives 65
Motives and cues in learning 67
Description and modification of motives 69
The psychology of purpose 71
The reputed law of effect 72
Motivation and the law of effect 75
Learning economizes action and anticipates the future 78
General summary 79

V. HUMAN MOTIVES AVAILABLE IN EDUCATION 81
Human engineering 81
The vital activities . . . 81
Animal behavior . 83
Reflexes with indirect adaptation . 84
Adjustments in the interest of the whole organism 84
The concept of instinct 85
Organic distress as a substitute for instinct . . . 86
Instincts in human psychology 87
Dominant human urges . . . 89
Distress arising from insults to the self 91
Distresses with a social basis . . . 92
Distresses due to thought and sympathy 93
Two general modes of relief 94
Emotion and instinct in human adjustment 95
A sample list of man's original activities or fundamental adjustments . . 96
The relative strength of motives 98
Practical applications . 100

VI. THE QUALITY OF THE ORGANISM; THE LEARNER . . . 104
The analysis of human traits . . 104
The comparison of different measures 106
Changes that occur in development 108
Laws of development 109
Psychographs of three pupils . . . 114
The pattern of mental ability . . 119
Mental patterns and general level of ability . . 120
Vocational and educational guidance 124
The developmental basis of prediction . 127
The effect of education on individual differences . . 130

PART II

TECHNIQUES OF INSTRUCTION

VII. THE PSYCHOLOGY OF TEACHING 137
The guidance of learning 137
Typical items of instruction 137
Enriching the pupil's experience 138

CHAPTER PAGE
Providing background and directing drill 141
Illustrations from the school subjects 142
Graphic spelling 144
Oral spelling 145
The motivation of the learner 147
Errors in spelling 148
The teaching of geography 149
Sample geography lessons 152
The technique of instruction 158

VIII. General Factors on Which Learning Depends . 161
Qualitative and quantitative studies . . . 161
Typical quantitative problems . . 161
Studies from which results may be derived . . 162
Curves of learning 163
Typical learning or practice curves . . . 164
The characteristics of learning curves 166
The teacher's use of learning curves 170
Learning as related to age . . 171
Decline of learning ability in adults . . 173
Individual differences in learning ability . . . 175
Variations in the individual learner . 179
Lapse of time and the effect of disuse . . 181
The psychology of forgetting . . 184

IX. Details of Management in Instruction 189
An experiment in the technique of impression 189
Various sorts of impressiveness 190
The effect of repetition ✓ 191
Most effective distribution of practice . . . 192
Attention-getting devices . . . 194
The direction of attention . . . 196
Avoid the conflict of half-learned acts . . . 197
The advantages of attempted recitation ✓ . . 198
Global versus piecemeal learning ✓ 199
Knowledge of results 201
Providing effective motives 203
The avenue of stimulation 206
Concrete materials versus symbols ✓ . . . 209

X. The Psychology of Classroom Methods . . . 212
Classical procedures 212
The method of apprenticeship 212
The life-career motive . . . 214
The classroom drill . . 215
Flash cards as instruments of drill . . 218
The inductive or "logical analysis" method . . 219
An illustration of the Herbartian method . 221
Limitations of the method 222
The purposive problem method 223
An illustration of the problem method 225
Various forms of the purposive problem method 226

CHAPTER PAGE

The psychology of the purposive problem 227
The project method of teaching 228
Variations of the project method 231
The psychology of the project 232
Social possibilities of project teaching 234
Discovery versus learning, again . . . 235

XI. MEASUREMENT IN EDUCATION 237
The need for measurement . . . 237
Some of the problems of measurement . . 239
The measurement of a single activity . . 240
The need for standards 241
Sources of standards 241
Backgrounds for interpretation 242
Scales and instruments 243
The measurement of general ability 245
Group tests of intelligence . . . 246
The measurement of special abilities . . . 249
The measurement of emotion and character . 251
The measurement of school achievement . 252
Measurement in arithmetic 253
Measurements of reading 255
Omnibus tests of school achievement 260
New type examinations 261
Some practical considerations 263

XII. THE EDUCATION OF EXCEPTIONAL PUPILS 266
The psychology of special education 266
Sensory and motor handicaps 267
Defects of speech 268
The education of the dull 269
Educational possibilities 271
The intellectually gifted 274
Studies of gifted pupils 276
Superstitions about gifted children . . 279
Experimental education of the gifted . 280
Achievement in subsequent career . . 282
The psychology of "homogeneous grouping" . . 284

PART III

PSYCHOLOGY OF SCHOOL SUBJECTS

XIII. EDUCATION IN A SENSORIMOTOR SKILL—TYPING . . . 291
The sorrows of an unguided pupil . 292
A preliminary analysis . . . 294
First step in cue reduction 296
The second step in cue reduction . . 296
Further abbreviations . . . 297
Reduction of tactual-motor imagery 299

CHAPTER PAGE
Perfection of the letter-writing stage 300
Cue reduction in higher order habits 300
Details of perfection 303
The learning curve for typing 304
The work curve for typewriting 304
Incidental influences affecting typing 306
An extraneous influence measured 307
Vocational guidance and typing 309
Studies of the typewriting curriculum 311
Measurements in typewriting 314
The function of the instructor 317

XIV. LEARNING ON A SYMBOLIC LEVEL—READING 320
The meaning of reading 320
The complexity of reading 320
Reading as visual exploration 323
The psychology of oral reading 325
Cue reduction in reading 327
Scope as a factor in reading 330
Reading for understanding 331
An analysis of meaning 333
Reading and thinking . 335
Special problems in the teaching of reading 336
Rules for the improvement of reading 340
The reading program . . 341

XV. KNOWLEDGE AND THOUGHT OUTCOMES—SCIENCE TEACHING 344
Skill, knowledge, and appreciation 344
Social, physical and natural sciences 344
The objective of science teaching . 345
The psychology of arithmetic . . 346
Arithmetic, the manipulation of symbols 348
Aims of science teaching, illustrated by arithmetic 349
Arithmetic as reasoning . 352
Scope, or sagacity 353
Joint action of cues and controls 353
The function of arithmetic 354
The nature of concepts 355
Concepts in arithmetic 356
The evolution of concepts 356
Generalization in teaching 357
Methods in science teaching 359
Motivation in science teaching 360
Thought controls and science teaching 360
Educational measurement in science 361
Permanence of learning in science 362

XVI. THE ARTS OF EXPRESSION AND APPRECIATION 367
The language arts 367
Cue reduction in handwriting 368
The psychology of drawing 372
Motivation in the expressive arts 374

CHAPTER PAGE
The influence of experience on composition 376
Limitations of creative expression 377
The psychology of music 379
Measurement in the expressive arts 381

XVII. Education for Mental Health 385
Appraise the self honestly 386
Cultivate an objective attitude 386
Meet reality face to face 387
Avoid mental limps 388
Emotions are signs of distress 389
Mental health demands repression 390
Happiness depends on irritants 391
Cancel your denominator 392
The saving grace of skepticism 393
Intelligence and mental health 394
Cultivate adaptability to insecurity 395
New habits for old 395
Learn to walk alone 397
Mens sana in corpore sano 398
Mental health and work 399

PART IV

GENERAL EDUCATIONAL PROBLEMS

XVIII. Transfer of Training and Formal Discipline . . 405
A brief historical introduction 405
An illustrative experiment on transfer 407
The experimental results . . . 408
Interpretation of the results . . 410
The influence of common elements . 411
The disciplinary values of high-school courses . 412
What determines the amount of transfer? . . 416
Importance of control in transfer 417
The teacher's responsibility for transfer 418
What cues can produce transfer? 420
Transfer of thought, feeling, and conduct . . . 421
What may the pupil transfer from a lesson? 422
Why transfer can never be complete 424

XIX. Psychology and the Curriculum 431
Questions about the curriculum 431
An example from Plato 432
An example from Comenius 433
A more modern illustration 434
The method of job analysis—spelling . . . 435
The inventory of immediate needs . 438
Corrective training as a basis—physical education . 439
A curriculum based on pupil interests—reading . 441
Expert opinion and the curriculum—arithmetic . . 443

CHAPTER PAGE

Objective social survey as a basis—geography 444
Planning a college curriculum 447
Psychology only a contributing factor 449

XX. The Behavior of School Children 452
Normal trends in behavior 453
The elementary school years 454
Trends in the high-school age 457
What do teachers call misbehavior? 459
The criteria of misconduct 460
School conduct as related to age and sex 462
School misconduct and intelligence 464
The incidence of truancy 467
The misrepresentation of facts 468
Experimental studies of deceit 470
School behavior and delinquency 472

XXI. The Psychology of the Teacher 476
Distribution of the pupil population 476
Socio-economic background of teachers 479
What are the desirable traits of teachers? 480
Teacher-rating cards and scales 482
Correlation of traits as rated in teachers 486
Teaching efficiency and intelligence 487
Intelligence status of teachers 488
The measurement of teaching efficiency 490
Trade tests for teachers 492
Student opinion of teachers 494

XXII. The Psychology of Educational Change 498
The instability of education 498
Complexity as a cause of change 498
1. The lack of scientific foundations 499
2. The introduction of scientific inquiry 499
3. The instability of democracy 500
4. The reflection of world changes 501
5. Lapse of time as an influence 501
6. The prolongation of infancy 502
7. The spirit of the age 502
8. The emphasis of the individual 503
9. The dynamic psychology 504
10. Changing cultural ideals 506
11. The loss of frontier life 506
12. Shifting character of the school population 507
Summary of the causes of instability 508
Prospects for future stability 508
Educational neuroses 509

XXIII. The Place of Psychology in Education 514
Major aspects of education 514
The philosophy of education 514
The history of education 516

CHAPTER PAGE

Educational administration 516
The scope of educational psychology 517
Representative psychological issues 521
Various relationships 525

INDEX OF AUTHORS 529

INDEX OF SUBJECTS 535

ILLUSTRATIONS

FIGURE PAGE
1. Substitution Test 19
2. Diagram of the Learning Process 32
3. The Famous Muller-Lyons Illusion 44
4. Map for the Analysis of Mental Control 54
5. Curves of Growth . 112
6. The Growth in Mental Age of Groups of Individuals of Different Intelligence Levels 113
7. Curves of Mental Growth 113
8. Psychograph of Boy A 115
9. Psychograph of Boy B 116
10. Psychograph of Boy C 117
11. The Course of Learning of a Defective Child 128
12. The Course of Learning in Defectives and Normal Children 129
13. The Result of Learning . . 138
14. Analysis of Teaching . . . 140
15. Distribution of Errors in Spelling 149
16. A Photograph of Reality Representing One of the Early Stages of Cue Reduction in the Teaching of Geography 151
17. A Relief Map Representing a Stage of Cue Reduction Later than that Represented by a Photograph . 153
18. A Sectional Map Referred to in the First Geography Exercise 155
19. The Map Referred to in the Third Geography Exercise Representing a Relatively Late Stage of Cue Reduction 156
20. Learning Curves for Three Different Tasks . . . 164
21. The Practice Curve as an Aid to Motivation in Penmanship or Other Objectively Measurable Work 171
22. Change in Code Performance with Increasing Age 172
23. Age Curve for Code Learning . 174
24. Age Curve for Code Learning . . . 175
25. Learning Ability of College Students 176
26. Showing the Distribution of Learning Ability in the General Population . . . 177
27. Influence of Alcohol on Code Learning 180
28. A Curve of Forgetting Material in Lectures 182
29. A Curve of Forgetting for Non-Sense Series 183
30. A Curve of Forgetting for Meaningful Material 184
31. Forgetting as Related to Degree of Learning 186
32. Practice in Writing Numbers for Letters According to a Key . 194
33. Showing the Effect of Exhibition of Scores on the Rate of Learning 202

FIGURE PAGE
34. The Influence of Approval, Disapproval and "Listening In" on the Approval of Others . . 204
35. Four Studies of Distribution of Teachers' Marks . 238
36. Unit from the Ayres-Burgess Scale . 258
37. Improvement in Typewriting . 301
38. Showing the Effect of Continued Work on Different Tests . 305
39. Influence of Caffeine on Typewriting . 308
40. Relative Frequency of Letters Used in Typing . 312
41. Individual Progress Record, Blackstone Typewriting Test 315
42. Percentile Curve in Typing for Groups with Different Amounts of Instruction 316
43. Showing Actual Achievements in Reading, Speed and Comprehension, in the Grades of School A and School B, Compared with Standard Norms for the Various Grades 339
44. Variation of Undesirable School Behavior with Age in Boys and Girls 463
45. Percent of Children Manifesting Behavior Problems at Different Levels of Intelligence 465
46. Distribution of I.Q.'s of Repeated Offenders . 467
47. Percentage of Truants of Different Degrees of Intelligence 468
48. Increase of School Population . 478
49. Elimination from School . . . 479
50. The Educational Pyramid 519

PART I

PSYCHOLOGICAL FOUNDATIONS

CHAPTER I

INTRODUCTION

The aim of education. Education, as part of an individual's experience, is one of the major features of life. As an organized social activity, it is one of the most elaborate of human enterprises. In a sense every creature receives an education; even a wild animal has much to learn about the world into which it is born, and profits from its experience. In the case of domesticated creatures education plays a still more important rôle. Training is administered by others, with deliberate reference to the wishes and needs of others, as well as to the fortuitous impulses of the individual. Human creatures are highly domesticated, that is, civilized, and this is largely due to the educational shaping of the young human being.

The ultimate aim of such education may be said to be a double one. On the one hand it is the desire to save the individual from troubles which he might encounter if left with only his native resources; on the other hand it is the desire to save other members of the social group from those troubles they would have to endure from untrained individuals. Briefly, the aim of education is to make human life happier for all those concerned with it. Agriculture, industry, navigation, mining, are ways of reducing or preventing human distress. So also is education; socially conceived, it is an organized technique for reducing human misery.

Experience is the only teacher. There is an old saying, often quoted with much seriousness, that "Experience is the best teacher." As is the case with so many of these common sense maxims, the doctrine does not stand up well under close examination. The element of truth in it is so broad as to make its statement scarcely instructive. Of course experience is the best teacher; it is in fact the only teacher, and hence the maxim is meaningless. The real questions are: "*What* experiences are the most instructive?" "*Whose* experiences can be made to count effectively?" "*When* is a given experience most educational?" "*How* can instructive experience best be provided?" and so on, into more and more minute details.

For me to break through the ice and drown is experience. But through such experience I learn little. Watching another person break through the ice and drown is more instructive for me, but it also is an experience. Seeing a picture of a man struggling for a foothold on the broken ice; being told in words by a companion, a parent, a teacher, that it is dangerous to go on thin ice; reading a newspaper account of such an accident; all these also are experiences. And they have their various degrees of instructiveness.

In other words, hearing of the experiences of others is also an experience. Because of this fact one may "vicariously" or "at second hand" experience things that never actually happen to him, and such vicarious experience may be presented in a great many ways. The real educational question then does not have to do with the value of experience, as contrasted with something else. Experience is the only available educational instrument. The only question that can be raised relates to the merits of various sorts of experience.

Education as an experimental venture. Two consequences follow from the fact that experience is the only teacher. The first of these is that "education" cannot be sharply distinguished from "life." Mere living, working, playing, watching, remembering—these are full of educational value to those capable of receiving it. On the other hand it seems reasonable to suppose that the more closely "schooling" articulates with other activities of living, the more educative it will be.

The second consequence is that this fact puts education on an experimental basis. Unless there is some supernatural revelation of the relative merits of various sorts of experience, the agencies of education must themselves experiment with various methods of instruction. A method of instruction is nothing but a particular set of experiences to which the learner is submitted. In education, as in any experimental undertaking, it is often important to recognize that final answers cannot be delivered until all the experiments have been tried.

Fields of education. However unified a project education as a whole may aspire to be, the student of education finds it convenient to consider that subject under several viewpoints, to divide the subject into minor fields or aspects. There is, for example, the *philosophy* of education, interested in and responsible for problems of general purpose, aim, or "objective." There is the *history* of education, interested in and responsible for the records of past trials and successes, and their interpretation for the control and guidance of new endeavors. There is educational *administration*, with its many responsibilities concerned with the executive management of the instruments, the machinery and the personnel of education. There is also educational *psychology*, with interests pervading the whole enterprise of education. Learning, however otherwise defined, is a mental activity. Since psychology is the science concerned with mental activities, we may expect that everything that has to do with learning or teaching will have its psychological aspects. To master all the psychological aspects of every educational topic is a large task—perhaps a larger task than any individual student of the subject can handle in a lifetime. We must therefore limit ourselves to representative topics which may assist in giving the student a general view of the field as a whole; which will introduce the more fundamental psychological principles to be encountered almost everywhere; and which may point the way to the solution or investigation of problems not explicitly considered in our own account.

A brief glance forward. It may serve a useful purpose to indicate in a very brief survey the general project which the following chapters will seek to develop. The chapters will be found to fall into four large divisions, although, in anything dealing with human nature, almost everything overlaps with almost everything else.

In the first section, on "Psychological Foundations," four chief topics will be considered. The first will be the general nature of learning—the process underlying all educative experience; second, the factor of control or balance, which, when adequate, enables learned acts to occur in appropriate circumstances, thus giving relevance or sagacity to conduct; next, the nature of motives, the dynamic agencies in all activity, and their rôle in learning and teaching; finally, the characteristics of individual learners, which distinguish them in important ways from one another.

In the next section, under the heading "Techniques of Instruction," the art of teaching will be considered, and a psychological analysis of that process undertaken; the engineering of learning, based on experimental results, will give a basis for the discussion of the management of instruction, special classroom and other teaching procedures; methods of measurement to be used in determining capacity for learning, rate of progress, and level of achievement belong in this section, as do also the special methods used for exceptional pupils and the technique of adapting teaching procedures to individual differences among the learners.

In the third general section the chapters will deal with representative school subjects, and the psychology of their mastery. Typing, as a sensory motor skill, will be analyzed and may be compared with learning in the case of a more symbolic character, as in the case of reading. Changes in knowledge and thought will be approached through a discussion of the teaching of the sciences; changes in appreciation will be considered in connection with the teaching of the expressive arts, such as language, writing, drawing, music. A special chapter on mental health will deal with the possibilities of acquiring a stable and effective personality.

The final section will be occupied with an array of special topics bearing directly upon the work of the school—such as the topic of formal discipline, the construction of the curriculum, the behavior of individuals under school conditions, the psychology of the teacher, the important topic of educational change and instability, and a concluding discussion of the general place of psychology in education, in terms of past accomplishments and future problems.

The student will find at the end of each chapter a series of questions or exercises. Some of these bear directly on the topic of the chapter; others invite discussion of outlying themes. There is also provided for each chapter a series of references chosen because of their interest in connection with the general subjects of the chapter. Such readings will lead the interested student far more intensively and also more broadly into the field of educational psychology than he can be carried by the more or less arbitrary organization and content of a textbook.

PROBLEMS

1. Point out in detail some of the concrete ways in which a wild animal "receives an education."
2. Point out specific ways in which education (*a*) saves the individual from troubles he might otherwise encounter; (*b*) saves the members of the social group from troubles they would have to endure from the presence of uneducated persons in their midst.
3. Recall and describe any instances you may have heard of or observed in which savage or primitive people developed methods of education.
4. Describe several ways in which "vicarious experience" is provided in the schools you have attended.
5. Read in Booth Tarkington's *Penrod Jashber* the description of the boys' efforts to train their dogs, noting the various points at which they could have profited from a knowledge of educational psychology.
6. What is the basis for the traditional distinction between "learning by experience" and other forms or modes of learning?
7. Suggest certain notable ways in which the education of the schools has changed during your own lifetime.

8. Criticize the statement: "The great aim of education is to produce changes in original nature."

9. Why do you suppose it is customary to begin the study of education with its psychology, rather than with its philosophy, its history or its administration?

10. Can you mention any other educational "fields" in addition to the four main ones mentioned in the chapter?

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CHAPTER II

THE PSYCHOLOGY OF LEARNING

The first problem for the educational psychologist is that of discovering just what it is that occurs in an act of learning. Learning is what the pupil is engaged in; the direction of learning is the teacher's main task; so clearly is this true that the very places in which education is conducted are often called "centers of learning."

In the past a great mystery has been made of the act of learning, although it is not at all difficult to describe that process, once other considerations are left out of account. Those who once believed that demons or spirits or an unobservable "mind" had first to be taken into account, had great difficulty in understanding learning. So also did those who tried to imitate physiology and were sidetracked by quaint fancies concerning the possible changes going on in the tissues of the body, when one learns. Fortunately the educator need not wait until physiology is able to describe the changes in the glands, the muscles, the nerves, and the sense organs. Little, in fact, is yet known about such correlates of behavior or experience. The fanciful diagrams that are often drawn of the neurones, the synapses, the nerve paths, the brain centers, and the connections, seldom, if ever, represent known physiological facts. They are usually only diagrammatic pictures of the observed facts of experience and behavior. For the present we need to come face to face with a few actual cases of learning, and to arrive at a formulation of the facts that are there observable.

We shall consider in turn several cases of learning—the learning of lower animals than man, the learning of very young infants, of older children, and of adults. We shall limit our account to the easily observable and verifiable facts and shall see that in this way we can arrive at a clear picture of what learning is, at a definite set of laws of learning, and therefore at a useful set of principles for the guidance of teaching.

The learning of lower animals. We may begin with the description of a brief experiment on kittens, described by one of the most diligent students of human and animal learning.[1]

> Let a young kitten that has never had any experience with fish or meat of any kind be confronted with a row of small flakes of cooked fish, identifiable by shape, color and smell. It will examine and eat one flake.
>
> Another piece is set before it, and it repeats the examination (probably abbreviated) and the eating. And so on, so long as it is hungry, with abbreviation of the examination and full retention of the eating.
>
> The same kitten confronted in the same way by a row of small friable capsules covered with meat juice but containing weak acid will examine them and may take one into the mouth.
>
> It will not repeat the act often but will soon avoid the capsules.

Here is a very simple, but also a very complete and effective case of learning. The kitten learns to eat the fish flakes and to reject the capsules. We need now to analyze the cases, in order to see just what has happened in each. Observe that there is no change in the kitten's behavior. In the case of the first fish flake, he ended up by eating it; he continues to treat fish flakes in this manner. In the case of the first capsules, the kitten ended up by avoiding or disliking them; he continues to avoid such capsules. If we call what the kitten finally does with each object his "response," we see that no change in the response occurs.

We may call what precedes the response the "antecedent" or "stimulus" for this response. And we see from the account that although the response remains the same from day to day, there is a notable change in the stimulus or antecedent. Before "eating" occurred, the first time, a long "examination" was required. The kitten had to see, smell, and taste the fish flake before bolting it down. As time went on, we are told, this examination or antecedent was *abbreviated.* Upon *seeing and smelling* only, the fish was devoured; finally the mere *seeing* was a sufficient stimulus; the sight of the fish flake led to gulping it down. Learning is seen therefore to consist simply of this abbreviation of the examination; that is to say, learning consists in a *reduction of the stimulus* required to produce a given act. An act that once required a fairly elaborate antecedent comes in time to be touched off by a very slight feature of this antecedent.

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[1] E. L. Thorndike, *Human Learning* (The Century Co., 1932).

When the kitten was offered the capsules, we see that the learning process was quite the same. Before the earlier capsules were *rejected* the kitten had to see, smell, and taste them. In the course of time *mere seeing* of the capsules was enough to produce such avoidance or rejection. The kitten may be said to have learned different things. But the pattern of the learning was quite the same; learning consisted in a gradual reduction of the cue required to produce a given effect.

The reader is perhaps familiar with the traditional experiments in which animals are required to secure their food by finding their way through a maze, or by manipulating a latch or string in such a way as to open a gate which admits them to the food box. Observation of what animals do in such situations reveals the same pattern of activity. At first the animal must go through a great number of "preliminary" acts before performing the act that secures the food. He wanders into blind alleys of the maze and must come back again; he indulges in various movements such as scratching at the walls, trying to push through the bars, and the like, before finally making the movement that effects his release.

As time goes on this preliminary activity becomes reduced. From trial to trial now this and now that "useless" act drops out. Fewer "random movements" are indulged in, and the time required to arrive at the final and effective act becomes shorter. These have often been called "random or false responses." It seems clear enough that they are not responses; the response is what the animal finally learns to do, the terminal act. These preliminary activities are the "examination," and learning consists in the more or less gradual "abbreviation" of this examination. One after another these acts cease to be required; the animal no longer needs to "get them out of his system" before being able to proceed to the effective terminal act. A single feature of the original antecedent, such as seeing the maze path, smelling the food, or even being given some arbitrary signal, sets him scampering down the path to the food or adequately manipulating the latch which holds the gate shut.

Learning in infancy. We turn next to examples of learning in the case of human infants. Some of the earliest observations of infant learning may be made in the case of the feeding reactions. The following account is given by one of the observers of the activities of very young children.[2]

> With very few exceptions the only mode of behavior which from the very beginning is surely positive is the taking of nourishment. the newborn makes sucking movements when his lips are touched. [By the age of one month] the child makes sucking movements at the most varied opportunities, thus manifesting a positive turning toward the source of food even when the stimulation is insufficient.
>
> The one-month-old child observes other people just as little as other objects [but] reacts to the auditory stimulus of the human voice by sucking, as though it were a stimulus accompanying the occurrence of food.
>
> The child of one month, when brought to the lap of its mother, turns its head toward the breast.
>
> [At five months the child] when being fed with a spoon, opens his mouth as soon as the spoon comes near.

The learning process is here clearly enough described. The nursing or feeding reactions are at first made in response to an elaborate set of antecedents or circumstances—the child sees its attendants, feels their manipulation of him, hears their voices, smells the food, feels the touch stimulus on the lips or cheek. His response at that time is a response to this total situation. But as time goes on, single details of this situation, occurring alone or more likely in other contexts, are effective in producing the behavior at first aroused only by the whole situation. Again we have cue reduction; part only of the original stimulus is now required to produce the appropriate response.

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[2] Charlotte Bühler, *The First Year of Life* (John Day Co., 1930), pp. 44, 104.

A similar process of cue reduction is to be observed in the defensive reactions of the child, those movements which appear in order to ward off or to flee from unpleasant stimuli. We may quote in this connection another set of observations from Bühler.

> By the time the child is four months old he already exhibits definite defense and flight movements. And he begins to add new reactions.
>
> At six months he includes shoving aside movements of the legs in his repertoire. He also now begins to depart from an earlier behavior stage in which he made these movements only when he experienced a direct bodily contact, and at the age of six and seven months he exhibits defense movements as soon as the stimulus *approaches.*
>
> For example, he meets the hand that holds the dreaded cotton swab for cleaning the nose while it is only halfway, and he holds it avertingly off.
>
> The defense movements of the eight-months-old child which accompany his fear reactions—his kicking, his stretching out of his hands, and lifting them in that direction from which he expects danger—are already directed toward an object which has *not yet begun to do any harm.*

Here we see that the very *purposiveness* of such behavior is also due to the learning process. At first the response of defense is made in terms of the whole situation, with its visual, its auditory, its tactile and its pain components. Later fewer and fewer of these components are required. Finally the very earliest of them to occur, the mere sight of the approaching swab, for example, suffices to touch off a reaction appropriate to the whole situation as previously experienced. The child thus reacts to events *before they occur,* but only in the light of their past occurrences. Slight details of the situation now become effective signs or cues. The effective cue is so reduced that, as a result of the act to which it leads, the rest of the threatened situation may even be prevented or avoided. Here we find the elements of purposiveness and insight, and the fact of transfer, as they are to be seen more fully developed in later life.

These observations of what happens in learning may be emphasized by quoting similar accounts from another student of childhood, having also to do with the feeding situation, which plays so prominent a part in the early education of infants.[3]

> When the baby is fed, he feels a certain group of sensations—he feels himself held in a certain position and touched in a certain way . . . at the same time that a second group of sensations involved in his own actions of opening his mouth, sucking, etc. come to his attention. After a number of such experiences . . . when the little fellow feels himself put into the familiar position he begins automatically to open his lips and make groping movements with his head and mouth.
>
> Presently . . . the baby begins to make sucking and groping movements in response to specific items selected from the total situation of being fed. He begins to respond not only to the position that *accompanies* nursing, but to events that habitually occur a little *before* the feeding process begins. . . . By his eighth week Mrs. Hall's baby "had come to know that the placing of a napkin under his chin was always followed by food, for he closed his eyes and opened his mouth." In his twelfth week Mrs. Moore's boy had associated the sight of his mother with food, for when he was hungry he would begin crying upon catching sight of her.
>
> As time goes on the details . . . become more and more numerous and less immediate, until the clatter of dishes in the kitchen, seeing some one lay the tablecloth or fill the tea kettle, or various other small signs come to have significance as advance indications of an approaching meal.
>
> In the fiftieth week the Fenton infant set every one laughing

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[3] J. C. Fenton, *A Practical Psychology of Babyhood* (Houghton Mifflin Co., 1925), pp. 152*ff.*

[while visiting at a neighbor's at tea time] by his greeting of the appearance of the tea things, for at the sight of the dishes he began making elaborate chewing motions, with comical solemnity and vigor.

If now we summarize these observations, without making any assumptions about the child's "mind," or about his "nerve tracts," we must say simply that the child behaves just as did the kitten in the animal experiment. In time he comes to "abbreviate the examination." He does not need to wait for the complete antecedent situation before making appropriate adjustment. Partial stimuli, slight features of the original situation, now serve as effective cues, and this is what constituted the learning process.

Learning before birth? It may even be suggested that learning, according to this simple pattern of cue reduction, goes on before birth. It may well be that many of the supposed *reflexes*, exhibited by the human infant at birth, have been learned. Take the simple nursing reflex, for example, the tendency to turn the head toward one side if the cheek on that side is gently pressed or touched. Suppose that, simply because of "random nervous discharge," during intrauterine life, the head be turned to one side. The result would be increased pressure on that side or on the corresponding cheek. This pressure would continue while the turning movement persisted and would thus become part of the stimulation that discharged into that movement.

Subsequently we might expect that such a stimulus, pressure on the cheek, although originally caused by a turning of the head, would become an adequate stimulus to such a movement. At birth, pressure on the cheek would be found *reflexly* to produce the movement of head-turning in that direction. It is to be observed that many of the so-called reflexes have this peculiar character of actually *producing* or increasing just that mode of stimulation which is conventionally said to be the cause of them. Thus pressure on the palm produces in the young infant the "grasping reflex." But notice also that grasping produces a pressure on the palm, by the tips of the fingers which press upon it. If learning is cue reduction, then many of the supposedly inherited reflexes may well enough be the result of educational experience before the moment of birth.

More advanced cases of learning (language). The pattern of learning, as we have seen it in the case of the kitten and the infant, is found also on more advanced educational levels. The same description applies, for example, to the learning of language, the learning of new codes, and learning to play a musical instrument. A brief account of each of these activities will serve to show how fundamental the general principle of cue reduction is.

We have already seen the beginning of language in the description of the infant's reaction to various items in the feeding situation. "The one-month-old child," we were told, "reacts to the auditory stimulus of the human voice by sucking, as though it were a stimulus accompanying the occurrence of food." The mere sound of the human voice, almost any sound, and almost any voice, in this way begins to be an element of language. The child comes to react to this sound as a sign, a cue or signal. Since it has so often been a part of the total situation leading to feeding, it now, as a partial feature of this situation, leads effectively to appropriate movements.

The sound of the voice thus becomes a symbol, and this is the basis of language. As time goes on, learning continues on a finer and firmer basis. One sound comes to be a sign of the nursing situation; another comes to be a sign of dressing; still another of going outdoors for play; still another for the situation of being put to bed; and so on. This "discrimination" is able to proceed only because *different* sounds are made to be *parts* of these various situations, by those in charge of the child. In time the child comes to have a reasonably large vocabulary of "understanding," long before he is able to make effective use of speech sounds by making them himself and in this way controlling the actions of other people. In just this way even dogs, kittens and horses come to respond to sounds as elements of larger situations. As experience and discrimination continue, even very slight details of the sounds come to act in different ways. The baby then behaves differently in response to its mother's voice than to the voices of others; even with the dog "his master's voice" affects the animal in ways different from that of other voices. In just this way all the different words in the vocabulary of understanding come to have their respective "meanings."

Other elements of language, such as written or printed words, come to be effective in the same way. At first they are made to be parts of general situations, and the child reacts to these situations in their totality. Each feature of the situation contributes its share to the total response, which is thus a response to the "whole context." In time the printed words themselves come to be effective signals; they lead, when they occur alone or even in other general situations, to behavior appropriate to the occasions in which they have been so often experienced. In this way, as "partial stimuli," they become signs, signals or symbols. Their effectiveness can be understood only by noting the more elaborate occasions in which they have repeatedly occurred. It is this that gives them what we call their "meaning," their "significance," their sign value.

The elements of language we see therefore to be "reduced cues." By virtue of the learning process, human beings and even some of the lower animals, come to be directed by objects and by situations which are not really or wholly present. The "names" of things come to affect us in the same way as do the things themselves. Little wonder then that primitive men and children, and even sophisticated grown-ups come to attach great value and importance to the names of things. Names are not to be treated lightly or "used in vain," for they affect people even as do the things themselves. The shepherd boy who cried "Wolf! Wolf!" produced such consternation among his fellows that we may be sure he was severely punished when it was discovered that no wolf was *really* there.

The nature of language, and the process of learning which its development involves, were very clearly stated by Edmund Burke, many years ago, in his famous "Essay on the Sublime and the Beautiful." Burke's statement was as follows:

> Words are in reality but mere sounds, but they are sounds which, being used on particular occasions, wherein we receive some good or suffer some evil, or see others affected with good or evil; or which we hear applied in such a variety of cases that we know readily by habit to what things they belong—they produce . . . whenever they are afterwards mentioned, effects similar to those of their occasions.

Code learning (substitution test). Once language has been acquired, it is easy to see how further learning takes place on the basis of it. It will be profitable next to consider what happens when a child who has developed to the point of being able to use a pencil, to write numbers, and to understand verbal instructions, sets about the learning of some new "code." A favorite instance in the laboratory is the "substitution test," a copy of which is here given.

On the main part of the page occur various geometrical forms, such as stars, triangles, squares, etc., placed in random order. At the top of the page there is provided a "key." Each geometrical form is there shown, and in each is a number that goes with it. The child is instructed to begin with the first empty form and go across the page, writing in each form the number that belongs there, according to the "key" at the top of the page. This amounts to learning a new "code," since the child does not know beforehand which number goes with each form. He is therefore allowed to refer to the "key" as often as he wishes, and in the beginning he must make full use of the "key" in order to *discover* each time what number goes into the next geometrical form. With watch in hand, we measure the time he requires to complete each line of the page. We can thus compare his speed in the first half with that in the second half of the test. Or we can compare his total time for this page with his time for another page done on some other occasion. Or we can compare the speed of different learners when set to accomplish the same task. Since we watch him and say "No!" promptly whenever he makes an error, and direct him to correct it, the only "variable" is the time required for a perfect completion of the test.

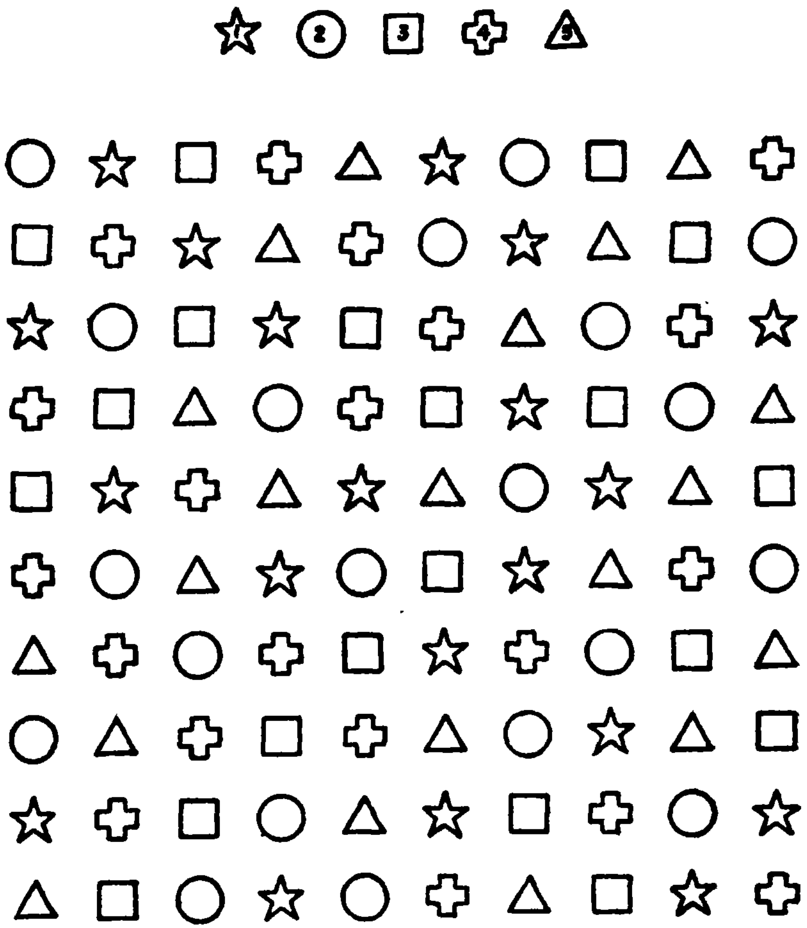

Fig. 1.—Substitution Sheet.

For the present, however, we need pay no attention to these measures of the time of performance. What we need is a description of what goes on, and we can secure this description, partly by noting our own observations of the performance and partly by asking the child to tell us what he observed concerning his own behavior during the process. We shall find that something like the following would be a true description.

In the beginning he did not "know what to do"; it was necessary to look up at the "key" at the top of the page in order to *discover* what number should go in each of the forms. The first form on the first line he looked at; it was a circle, and he said to himself "circle." Then looking up at the key, still thinking "circle," he located the circle in the key and found in it the number 2. He then said "two," "circle-two," and looking back at the test line wrote a 2 in the first form, the circle.

This had to be gone through each time, for each of the forms, as they came in turn. When the circle came again, also in the first line, he still had to look back at the key. But as he went on from line to line he observed that he was able to "abbreviate the examination" more and more. Soon he did not need to say "circle-two" when a circle came; he quickly glanced at the key and wrote the proper number; he was able to *dispense* with some of the stimulus that had previously been required.

In time, the moment he saw a circle in the test sheet he found himself saying or thinking "two" and writing this number in the form, perhaps after hastily glancing at the key to make sure. As he went from line to line, down through the test page, he found himself resorting less and less to the key. After a time he did not even speak or think a number when seeing a form; instead he merely wrote in the form the number that belonged there. By the time he had reached the last line this preliminary was so far reduced that it was not even necessary to explore the forms carefully; just seeing one corner of the square, one arm of the cross, one point of the star, was enough to start him writing the correct number.

If we put the child through this test a sufficient number of times we shall shortly see that he need not even see any part of the forms on the page. He can begin and write down "by heart," the proper numbers for all the figures in the first line, or even for more than this. The mere writing of one number is now a sufficient "cue" to lead to the writing of the next number. The required stimuli have been so far reduced that no cues need appear in the field of vision; all the necessary cues are provided by the writing movements which the child makes, once these have been set going.

As a result of this process of cue reduction or learning, the time of the performance, line by line, becomes much shorter. At the end of a few such trials the child can write the proper numbers as fast or nearly as fast as he can make his fingers move, although in the beginning a very long time was required. The description of "what went on" during the repeated trials gives us a *qualitative* picture of the learning; study of the time required at different parts of the process would afford us data for a *quantitative* analysis. By both these methods we should be able to study the effect of various changes which we might introduce into the situation.

Learning to play the piano. If we turn now to the case of a child learning to play the piano, we see that the pattern of learning does not change. A good deal of previous learning has taken place before a child is given piano instruction. As a result of growth, he has acquired muscular abilities not possible to younger children. He is therefore at the start able to push down the keys of the piano, to sit up on the piano stool, to fix his attention on the music score, to say the letters and numbers which he finds printed there alongside the musical notes. But he cannot "play his piece," and in order to be able to do this he must pursue further *learning*. Let us see in what this further learning consists.

Looking at the music sheet he sees a black dot on a certain line and has already learned that the verbal name of this dot, occurring on this particular line, is "c." Perhaps a letter "c" is there beside it in the beginning. There is also a number, which refers to one of his fingers. Seeing this dot, seeing the letter, seeing the number, he then looks away from the music score and down at the keyboard. There he finds black and white keys in certain positions, and he has already learned their letter names, or perhaps in the beginning each key bears a letter which belongs to it. So, while thinking "c" and "1" he finds the "c" key on the board and pushes it down with his "1" finger (forefinger). He has then successfully followed the instructions and "played the note."

He may then proceed to look back at the music, find the next note, and continue in the same way to produce it on the piano. But the production of each note is slow and laborious. Each note requires so much preliminary examination, so complex an "antecedent," so elaborate a "stimulus," that the notes come far apart. When sounds come far enough apart they no longer constitute a melody or tune. Therefore although the novice may be said to be able to play the notes, he cannot be said to play the tune.

If the student perseveres we then see that the necessary preliminary examination or antecedent becomes much "abbreviated." Shortly he need not notice the letter names of the notes; he need only observe the fingering instructions, then, looking at the keyboard, play the proper note with the proper finger. In time even the fingering instructions can be omitted; merely seeing the note on the staff leads to pushing down the appropriate key with the proper finger, although it may still be necessary constantly to glance back and forth from music score to keyboard. But with further practice the keyboard need no longer be watched. With eyes fixed on the music the pupil adequately and promptly plays the proper keys, and behold! they now come so close together that his auditors recognize the melody. He is now able to "play the piece."

But at this stage he must still see the music score; if the room is darkened, he is at a loss, for he is not yet able to dispense with the visual cues. With further practice however he reaches a point at which, in the dark, or with his eyes closed, he is able to begin and to complete the playing with no reference whatever, visually, either to the music or to the keyboard. We now say he has "learned his piece by heart."

The cue reduction has now gone so far that the mere feel of the movement of preceding notes, or the sound of them as struck on the piano, leads effectively to the next note. No cues need now be provided by "the outside world." The only cues required are provided by the learner himself—they are those slight and subtle experiences originating in his own body, the feeling of his own movements in the final stages of practice. And these are cues which do not "occur" anywhere except in his own individual experience; that is what we mean by saying the learner has mastered the piece "by heart."

It is instructive to note the great similarity between this performance of the pupil in learning to play the piano and the activity of the lower animal in securing its food by finding its way through a maze. Of course in the former case this situation is more complex; finding a single note is perhaps comparable to the animal's finding its way to the food box.

But in both cases the learner in the beginning required "a great deal of stimulation." He indulged in a great many acts which to the ignorant bystander might appear to be "mere by-play" or "just random activity." As a matter of fact there was nothing random being done. In each case a complex antecedent had first to occur before the terminal act was achieved. Considerable "exploration" was required before this final act could occur the first time. But this was not *learning;* this was *discovery.* Learning consisted, in both cases, in the gradual reduction of this necessary antecedent until very small portions of it were as effective as the whole had been in the beginning.

Learning to drive a motor car. Let us now take a final case from the learning of the adult in order to see whether anything new is encountered on that level of development. Many adults have learned to run automobiles, and this is a process which often requires a good deal of teaching. It is also a process of such a common sort that any one can verify our analysis, either by remembering his own learning or by watching the learning of another person.

Of course there are a great many different things to be learned in the driving of a motor car. Since we cannot talk about all of them at once, and since they are not even all learned at once, we may select some one part of the process and consider the way in which it is learned, in the typical case. Let us consider so simple a part of the process as applying the brake.

Initially before the brake is applied, the learner finds it necessary to go through a fairly elaborate antecedent process. In the very .beginning he must first look down at the pedals, put his right foot on the one he has learned to call "the brake"; he must think or say to himself, "First throw off the clutch" and perhaps "Depress the throttle." He must then find the clutch pedal, often by looking about for it, put his foot squarely upon it, push it down. Then he finds that his foot has slipped off the brake pedal, so he must find this again, put the correct foot upon it, push down at the proper rate and to the proper extent. Then recovering, he must grope about for the gear shift lever, remember which position is neutral, and throw into this position. Then he sits back, wipes his forehead and breathes a sigh of relief.

And well he may. For that simple terminal act, applying the brake, at first requires a very complex set of antecedents. But with continued practice what we find to occur is the following. Soon the driver ceases to say or think anything at all; he no longer talks to himself in the process, for he can dispense with this sort of guidance. Later he need not even look about with his eyes to find the proper pedals and to see that his foot is really on the pedal instead of on the accelerator. Feelings from the limbs themselves (tactile and kinesthetic cues) come to be sufficient guides or stimuli. He need, in time, not even wait until the throttle is adjusted before beginning to manipulate the clutch, nor wait until the clutch is in place before beginning to depress the pedal or to come into neutral.

Instead, a very slight feature of the original situation, such as a word from the driving instructor, the appearance of a red light, or the sight of a pedestrian or another vehicle crossing his path, or perhaps just saying to himself, "Well, I guess I'll stop," is enough to touch off the series, each phase affording subtle cues to the production and guidance of the next. The terminal act in this case is of course not simply "pushing the brake." It is a fairly complex pattern of motor adjustments, in a very particular sequence. But even such complex coordinations can come to dispense with their original complex antecedents and effectively follow abbreviated or reduced cues. And that, as we have seen in all our examples, is just what we mean by learning.

The learning of more subtle acts (thoughts, feelings, attitudes). In the examples we have been discussing we have purposely chosen cases in which the "terminal act" or response was an overt or easily observable movement on the part of the learner. We have done this only in order that the process might be easily checked up and verified. But precisely the same principle of learning also applies in the case of mental images, thoughts, feelings, attitudes, decisions, judgments and other types of behavior or experience. In such cases the process is sometimes not so obvious, and more careful observation is required. Often this observation must be made by the learner himself, who reports to us his own private experiences or acts. This process has been misleadingly called "introspection."

Take the occurrence of visual pictures, for example. In the presence of quite a complicated situation, comprising the action of an object upon the sense of sight, with various attendant circumstances, including perhaps the sound of the name of the object, I get what I call "a visual perception" of that thing. This is a very vivid experience or event, and the physiologist has much to say about the complexity of the situation required to produce it. Vibrations must fall upon the sense organs; there a chemical change is produced, which in turn causes a wave of nervous energy along my optic nerve. When this arrives, after a fairly circuitous route, at certain brain centers, and only then, there occurs that vivid event which I call "seeing the object." We need not concern ourselves about this process now. In the first place no learning is involved in it in any obvious way; and furthermore there is still a great deal of mystery left to the process, even after the physiologist has told his story.

More psychological is the fact that after such experiences we find that "reduced cues" enable us to get fairly good visual pictures, without the occurrence of this complex set of antecedents. Having seen the moon, let us say, in this way a few times, I find that all that is necessary is for some one to speak the word "moon," and there occurs in my experience a reasonably definite and recognizable visual picture, which I call "an image of the moon." This picture is, to be sure, not so vivid and distinct as was the original experience of "actually seeing the moon." This fact will have considerable interest for us at a later stage. For the moment we are interested merely in the fact that even visual pictures appear in response to "reduced cues," such as words. In fact we call such pictures *mental* images just because they are produced in this way.

Feelings and emotions may also result from partial stimuli. Having once or oftener been severely frightened by having a vicious dog attack me in a certain part of the neighborhood, it is not necessary to be attacked again in order to have feelings of apprehension or fear. Fear comes whenever I go into that territory; *any* dog arouses me to timidity; even *other* animals, somewhat like dogs, produce a feeling of aversion. The very word "dog" comes to have an unpleasant sound, comes in fact to be a "dreadful" word. This again, is a simple case of learning. Mere fragments, reduced cues of the original situation, are now effective in arousing feelings or emotions appropriate to the situation as a whole. I may in this way even come to fear many things that "are not there." It is necessary only that *something* be there which was *part of* the original situation or antecedent.

In just this way we *learn* to be exhilarated by the sound of a trumpet; depressed at the sight of a grave; expectant at the sound of a beloved voice; down-hearted at the "signs" of the weather; serious at the appearance of the cross; animated at the unfurling of the flag; hungry at the smell of chocolate; interested at the mention of certain topics; suspicious of members of certain organizations, professions, races.

In just this way attitudes and habits of politeness, of honesty, of truthfulness are inculcated. Note for example the way in which very simple habits of etiquette are taught to a young child. While he and I are going down the street I say, "Look, there comes a lady. Ah, it is Mrs. J. . . . Now get ready to tip your hat. Look at me, see, this is the way I do it. Here she is. Ready, go!" Whereupon he takes off his cap. But this is *discovery;* there is as yet no *learning.*

With a likely pupil, however, cue reduction proceeds apace. In time it is no longer necessary to go through with these rather exaggerated and pedantic instructions. At the words, "Here comes a lady," or at the mere sight of the lady approaching, the apt pupil comes to doff his headgear. He has come to dispense with or to "abbreviate" the examination. Slight features of the original antecedent become effective in producing the terminal act. When this has occurred, we say he has acquired an *attitude* of politeness. By this we mean not that he has assumed some strange and permanent posture; but merely that we can now count on the reduced cues or signs as effective stimuli to the desired response.

Discovery and learning. Before learning (improvement) can take place, the materials must be in existence that are to be improved. There must be a set of antecedents which do eventuate in the desired act. Before *learning* can begin, *discovery,* first experience, must occur. Failure to recognize this distinction will lead to confusion. It is easy to confuse discovery and learning, because in common speech we often use the word "learning" wrongly, to mean the discovery, once for all, of something which may never come to be better done or known. Before the pupil can *learn a lesson* he must first *learn what the lesson is.* But this is using the same word in two senses. In the second sense it means the same as "finding out," "ascertaining," "securing" the materials to be *learned* in the correct sense.

A farmer may learn (discover) whether or not there is oil under his land; he may learn (ascertain) the price of wheat to-day; he may learn (experience for the first time) what Milton's *Areopagitica* is. In this way also the pupil *discovers* the substitution test and code, discovers the typewriter and copy, before he learns. In fact, discovery, initial experience, must always precede learning. Materials must be available before building can be accomplished. The *first achievement* must occur before mastery can develop, before improvement or learning can begin.

In some cases the first achievement is all that is of interest. When the farmer discovers that he has no oil land; when the pedestrian discovers that it is raining, the process is finished. These discoveries add to knowledge; they increase information; they extend the range of experience; they are an important part of education. But the first confronting of facts, the first execution of an act, should be as carefully as possible distinguished from the further process of perfecting one's skill in their use.

Discovery is an important art. The *having* of experience must precede training, in the psychological sense. Pricking an infant with a pin is furthering its experience and *may be* the first step in an act of teaching; on the other hand it may not and need not be followed by learning. It is the initial sequence of antecedent and consequent, without which learning, as cue reduction, cannot occur; but this does not make the two identical.

Suppose that instead of providing the pupil with the necessary materials and instructions we simply decide that we wish he would draw a map of China. We do not reveal this wish to him; at the most, we might tell him that there is something we have in mind, and that if he does it and does it well we will grade him high and promote him. We would be acting like the animal experimenter who sat about waiting until "by accident" the encaged animal happened to pull the string that chanced to release him. Making the animal "restless" by setting food in the neighborhood would be only like pinching the pupil until he by chance drew a map of China.

The animal must make the initial discovery before it can begin to *learn.* If the pupil should, through some accident, discover what it was we were wishing he would do, that would be "finding out," but not *learning* in the psychological sense. If in this process he should learn anything it would be only how to guess better, certainly not how better to draw maps. Learning, in other words, we reserve to mean improvement in something. Before improvement in something can occur there must first be a "something." Before learning can take place there must be, on the basis of original nature, heredity, previous learning, or a combination of circumstances, a complex experience that results in a terminal act or event. This occurrence, this first exploit, will not be learning. It will be initial experience or discovery. The teacher, as we shall see, is responsible for both. Teaching must first enrich experience, facilitate first exploits, or at least make sure that these have occurred. It must then, through the course of cue reduction, facilitate and economize such behavior.

There are, among the traditional "principles of learning," some that apply particularly to this process of getting experience, making discovery, conducting investigation. They are such generalizations as trial and error, random activity, multiple response, attention and interest, mind set, variations of behavior, and the like. They may all be summed up in the brief exhortation, "Keep busy."

In animal experiments and in many experiments on human learning the subject of the experiment is required both to discover the materials and also to accomplish the learning. But in ordinary educational activities initial experience is in the main provided by the teacher, the curriculum, the school equipment and the general setting. We "set the stage" so that the desired outcome will shortly occur and can then be learned. It may also be useful to cultivate or teach the technic of investigation, and to formulate the principles of discovery. But such principles need not be confused with principles of learning.

Learning we can best reserve as the name for those changes which may follow upon the initial exploit, resulting in improvement of performance. It may well be that better learning will result in improved techniques of discovery. It may also be that a better technique of discovery and investigation will facilitate improvement. But the fact that the two processes may be mutually helpful is no excuse for failing to distinguish between them.

A diagram of the learning process. There are a great many facts known about learning, aside from the simple observations such as we have made. There are many special laws of learning, which vary with the time and the occasion, with the materials learned, with the learner, with the frequency and the vividness of experience, with the way the experience is presented, with the way the learning is measured, and a host of factors which it is the business of educational psychology to study.

With many of these details we shall later make contact. For the present we are interested in making clear *what learning is,* considered psychologically. And our conclusion is that we may define learning as *cue reduction.* Learning is that process in which small details of a total situation come to be able to produce an act or consequent which at first required the whole situation for its production. Another way of saying this, as we have already seen, is that learning is the process whereby signs or symbols come to have meaning.

It is essential to get it clearly in mind that learning actually *is* this process. The details of a situation actually come to produce the response appropriate to the whole situation of which they once were parts. They do this directly; they lead immediately to such acts, images, feelings or other results, just as directly as originally the whole situation led to such results.

We need not involve ourselves, as psychologists, with any metaphysical or physiological speculations. We need not suppose that the cue first rouses a demon, who thereupon proceeds to produce the terminal act. Nor need we assume that the cue must first stir up an "instinct" in "the mind," which instinct then plays upon the body to produce the appropriate act. Nor need we wait until physiology or chemistry or neurology are able to tell us what, in the meantime, may be going on in the various parts of the body. Whatever they tell us would be only another example of learning; instead of attributing the learning to the whole person such an account might try to show that the muscles, or the neurones, or the brain centers learned, that is, responded to partial stimuli.

Whatever the physiologist or the metaphysician may learn will no doubt be of great interest. But it will in no way modify our conception of the nature of learning. For learning is just what we see it to be; it is a psychological process, a process to be observed, as it were, in the gross—right there in the street, in the schoolroom, or elsewhere in the world at large. The laws of learning will be derived from observations of this process, and from experiments with it. The facts of learning will come first; the explanations of physiology, when any are really available, will come later, and they will be only a more detailed account of the same process.

In order to have a diagram for the net outcome of our descriptions of learning, we need only to represent the observations we have made in a schematic and graphic way. In doing this it should be remembered that we are not trying to portray nerve-process or brain activities, or anything of that sort. We are representing in the diagram the actual events which we have been able to observe, and which have been referred to verbally in the foregoing descriptions.

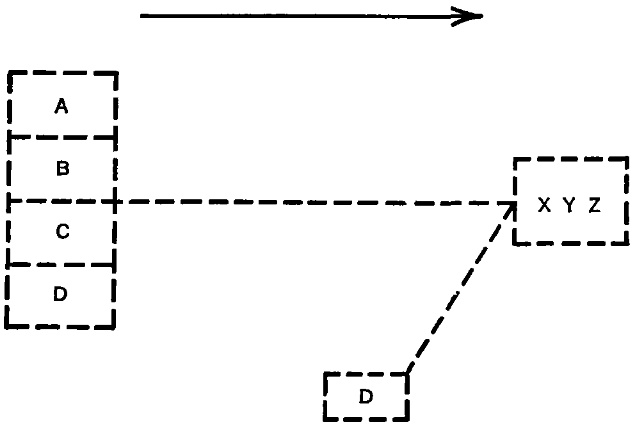

FIG. 2.—DIAGRAM OF THE LEARNING PROCESS.

In this diagram we represent the original necessary antecedent or situation by the rectangle *abcd,* including various components or features or details, *a, b, c,* and *d.* We represent the response made to this total situation by the rectangle *xyz,* thus indicating that this terminal act is also complex, made up of or involving various parts. The small rectangle *d* represents the later occurrence of a small part of the original situation, *abcd.* And we see, as shown in the diagram, that this reduced cue or detail *d* itself now leads to an *xyz* response, just such a response as formerly followed upon the whole situation, *abcd.*

In the case of learning, then, we always have (1) some definite act, event or response; (2) some effective cue which at the time is responsible for this consequent; and (3) in the earlier biography of the learner, some more complex situation which as a whole once or more often led to this kind of response.

With this analysis in mind, we are now ready to advance to the next level, which is made necessary because of the fact that ordinary learners are not usually affected by single, separate cues, acting in isolation, but by many such cues, acting in various relations of coöperation or interference.

PROBLEMS

1. Why do we know so little about the physiological or nervous correlates of such mental activities as learning?
2. Find some account in which hypothetical diagrams of brain and nervous action or architecture are offered as explanations for psychological phenomena.
3. Why is it desirable to begin an account of learning by examination of some of the simplest cases?
4. Describe some learning process you have observed in a child or a lower animal, noting whether it appears to correspond to the accounts here given.
5. Analyze your own experience in learning a foreign language or in solving a mechanical puzzle repeatedly, asking whether cue reduction seems to be the process involved.
6. Perform the Substitution Test given on page 19, taking the time in seconds, and note as you do the test whether the course of learning in your case is correctly described in the text.
7. Observe the errors you make in driving a motor car, and consider whether they are not often due to inadequate cue reduction.
8. Describe some experience in which strong feelings have been aroused in a new situation, because of some partial stimulus that was once part of an earlier emotional situation.
9. Substitute for the abstract letters of the diagram of the learning process more complete descriptions of the actual items, in some particular case of learning.
10. Show by examples that you have clearly in mind the distinction between the initial act of *discovery* and the subsequent process of *learning*.

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CHAPTER III

CONTROL AND MENTAL BALANCE

Control of the reflexes. In the description of the pattern of learning we have purposely considered the process in its simplest terms. The fact is of course that nearly any event in our experience and nearly every act in our behavior is complex. It is in itself analyzable and is a more or less elaborate *pattern* of related parts or items, in definite *organization.* So also the stimuli that produce it are likely to be complex; the antecedent of an act or experience is always a variety of stimuli, acting in patterns of facilitation and interference.

A very simple act, for example, is that known as the "knee jerk." When a point just below the kneecap is struck a light but firm blow, the lower part of the leg jerks upward, if it has been loosely hung over the other knee or over the edge of a table when the blow was struck. We are inclined to say that the stimulus to this act is the isolated event, the blow on the knee. But as a matter of fact it can be shown that the briskness and extent of this knee jerk varies not only with the intensity of the blow, but also with a great many other things going on at the moment—with the loudness of the sounds heard at the time, with the other movements (such as clenching the fist or jaws) the person is making, and even with certain ideas which he may be experiencing. The knee jerk, that is to say, is really a complex resultant of many of the stimuli playing upon the organism at the time it occurs. Some of these stimuli work together (synergy) by way of reënforcement; others interfere with each other (inhibition) so as sometimes quite to neutralize each other.

The pupillary reflex is another act that seems at first to be quite simple and quite simply produced. When the illumination is increased, the pupil of the eye shrinks in size (contracts); when the illumination is decreased, or a shadow thrown on the eye, the pupil increases in size (dilates). But it is wrong to suppose that the size of the pupil at any given moment is merely a function of the illumination. It can also be shown that the size of the pupil varies with the distance of the object looked at. When looking at a near object the pupil contracts; when looking at a more distant object the pupil dilates. Moreover, it can be shown experimentally that other influences, such as the sounds occurring at the time, the feelings experienced by the individual, and similar "stimuli," also have their effect on the size of the pupil at any given instant. Roughly speaking, the size of the pupil at any given instant is a response to the total situation just preceding that instant.

Degree of illumination can properly be spoken of as a stimulus to changes of the pupil. But it must also be recognized that normally the actual change in the pupil is a function of the total context in which the change of illumination occurs. At the given instant factors other than illumination are also exerting their influence. Some of these make for contraction; some make for dilation. The actual outcome will be a synthesis or resultant of all these influences present in the situation at the moment just preceding the measurement of the pupil.

Control in familiar activities. What is true of these relatively simple reflex acts is obviously true also of more complicated performances or experiences. If I have been frightened by the attack of a ferocious dog, the mere appearance, in my field of vision, of another dog tends to arouse a similar fearfulness. But the promptness and intensity of this fearfulness depend on many other things as well. If the dog bares his teeth and growls, the fear tends to increase; if I see that the dog is strongly chained, the fear is reduced; if I have in my hand a strong cudgel, this helps to diminish the fear; if I note that the dog is baring his teeth in order to attack another dog, this also tones down my apprehension, or may even prompt a very different kind of excitement and interest. Normally, at any rate, the feelings that arise at a given instant, are determined by the total life situation of the individual at the moment just preceding.

Consider the behavior of a man who lives in an apartment on the fifth floor, to which he ascends in an elevator. His exit from the elevator ought to be determined jointly by several features of his experience, by a variety of stimuli. He should not try to step out until the elevator has stopped; until the attendant has opened the door; until he sees appearing on the landing the correct number of his floor; until the lady who is also ascending has first gotten out with her baby carriage; until he has first picked up his umbrella, which he has leaned against a corner of the lift.

However, one who frequently uses such elevators may often observe passengers making "absurd" mistakes, or may even find himself making them. Thus he may start to leave the cage at the opening of the door, only to bump into the lady with the baby carriage. Or he may blithely make his exit when the door opens; avoid all collisions; turn down the hall toward what he supposes to be his apartment, only to find that the key does not fit the door. After a period of fumbling he is startled to hear a dog growl inside the apartment, and glancing up at the door is chagrined to note that this is not his apartment at all. He is trying to work his way into the corresponding apartment on the *third* floor, whereas he really lives on the *fifth* floor.

In such a case we can rather easily see what has happened. Getting out of the elevator ought *normally* to be determined by the joint effectiveness of several cues. But in the case of this man some of the available cues have not operated; he ignored the number 3 appearing on the landing just before the elevator door opened. Had he regarded this number his movements would have been restrained. Instead, at the mere opening of the door, this man stepped out of the elevator. He reacted to a *part* only of the actual present situation or context; he was oblivious to the total setting in which "opening the elevator door" occurred. It was this obliviousness to all the available cues of the present situation that landed him in his embarrassment, and might even have led to his being arrested for "illegal entry" and branded as a criminal. Knowing the facts, we do not bring any such accusation against him; we merely smile at what we call his "absent-mindedness."

Such observations as these introduce us to the concept of mental control or balance. By control we mean that normally action and experience are the joint product or resultant of the many influences, cues, or determinants that confront the individual at the moment of action. The various stimuli act as mutual controls, so as to produce behavior suitable to the situation as a whole. Action determined in this way we call relevant, appropriate, or sagacious.

Each cue in the present situation operates according to the laws of learning. That is, its effectiveness is determined by the past situations in which it has been a partial element. The sound of the opening of the elevator door is a mere noise; but as a mere noise, it has in the past been part of a situation in which the door was also *seen* to open, and in which exit from the elevator cage was found to be possible. Hence it now operates as a sign of that more complex situation.

The number appearing on the floor landing, considered in and for itself, is nothing but a crooked smear of paint on a rather dirty wall. But it has a definite shape, and this is the shape that in the past has been called by the name "five"; it represents the number of pennies in a nickel; the number of fingers on a man's hand; and also the floor on which the passenger's family resides. It has frequently been a part of the situation in which the passenger makes his exit from the elevator and successfully opens the door to an apartment in which he finds his own family. Therefore it may now operate as an effective cue for this situation, according to the general law of learning.

Docility and sagacity. Without learning, therefore, none of these cues would be effective. But we have also seen that they must be permitted to operate jointly, to control *together* the ensuing behavior, if this behavior is to be normal and appropriate. The illustrations we have used, and many similar observations that any one can make, suggest that such control or balance is not always present. There seem to be some *circumstances* in which it is less likely to occur than at other times; for the man who went to the wrong apartment usually gets out on the correct floor. There seem also to be marked differences between *people* in this respect; some we can usually count on to react with insight into the whole situation; others we dare not trust, for they are so likely to be touched off by some single element in a situation, and to act in terms of it, just as if they were blind to everything else that was going on about them.

We have seen that learning consists in cue reduction—in the development of effectiveness on the part of signs, symbols, or partial details of situations. If different people vary in the readiness or ease with which they show the characteristics of learning, we shall find it useful to have some word by which to indicate these differences. We might simply refer to differences in *learning ability*, or to differences in *capacity for cue reduction.* Or if a single word is desired, we might make good use of the word "docility," which in its original use means not tameness, but "teachableness." "Docility" then will be a convenient name for ability to learn, and degrees of docility will mean differences in the capacity for learning.

The second important principle of human behavior and experience we have seen to be that of the joint action, coöperation, or "synergy" of stimuli. This seems to depend on what might be called an "openness" to all the available cues afforded by the actual situation at the moment. Since individuals differ in this respect, and since the same individual shows different degrees of this trait from time to time, we also need some convenient term by which to refer to this fact.

Various words might serve the purpose fairly well. "Insight" might be a good term, except that it has a certain suggestion of the occult or supernatural, which we should prefer to avoid. "Alertness" would also apply, but it is so often used to imply merely "quickness" that it does not convey our full meaning. "Sagacity" has been used in discussions of this trait; but this word has various other uses which suggest such things as shrewdness, and the word does not itself suggest the character of the trait. Perhaps the best term for our present purpose is "scope."

The term "scope" we shall then apply as the technical name for these differences in "openness to stimuli." We may then speak of degrees of scope, or of breadth or narrowness of scope. By such terms we shall be able to refer to the range or degree of completeness of those cues in the present situation which may be seen to be effective in determining the behavior or the experience of the person in question. Docility and scope are then the first two important psychological facts with which the educational psychologist is concerned. We shall see that they have a very important bearing upon all the problems of education, whether in the schoolroom, or elsewhere in life.

Variability in learning and scope. The learning capacity or docility of an individual depends upon a great many different things. For one thing, it appears to change with age in the same person, other things being equal. Up to a certain age, which we call maturity, the child's learning ability appears to increase. In a later chapter we shall consider in some detail the relation of growth to learning. In the years beyond maturity also changes in learning ability appear; on the average there is a considerable loss as the result of advancing age. Learning ability has also been found to vary with the effects of drugs, with different degrees of fatigue, with conditions of worry, fear or distraction, and with many other conditions which it is the business of experimental psychology to investigate.

A most important fact is that learning ability, at a given *age and with other factors kept constant, is found to depend upon heredity. That is to say,* some people are constitutionally inferior in this respect, and a similar inferiority is likely to be found in their close relatives. Those who are relatively incapable of learning, who show low degrees of capacity for cue reduction or symbolism, we call feeble in mind.

Feeble-minded persons do not respond readily to signs or symbols. The whole original situation must often be presented again before they are led to react in the appropriate manner. Very simple and obvious sorts of symbols, such as pictures of things, gestures, and facial expressions may sometimes be effective. But to the subtler signs such as words, printed or spoken, they are relatively obtuse. Binet, a French student of feeble-mindedness and related conditions, found that imbeciles even seemed to enjoy being pricked with a needle; again and again they extended their arms to be pinched or pricked, grinning while they did so. Binet explained this by saying that in the average person the needle prick is unpleasant, not so much because of the rather slight pain sensation it produces, but because it serves at once as a sign of more painful or dangerous situations, in which such pain sensations have been a part. In the case of the feeble-minded, this sign value is not appreciated. The needle prick does not have any "meaning" for them; it does not function as a reduced cue for more dangerous experiences. Hence it amounts only to a mild excitement, which is not only not strongly avoided, but appears even to be mildly entertaining. We shall learn more about such incapacity for symbolism, in a later chapter in which we shall be concerned with the educational implications of such lack of docility or teachableness.

Scope or sagacity is also found to vary with different conditions. In the same person, for example, sagacity is decreased by sleepiness. In fact in that extreme degree of sleepiness which we call drowsiness, or half-sleep, it is just this weakness of scope that is responsible for the bizarre character of dreams.

Sagacity in a given individual seems also to be markedly impaired by emotional excitement. When frightened, we overlook many of the signs which the environment affords; we do not "take things in." When very angry, also, we neglect many considerations which we may subsequently wish had been allowed to influence our feelings or our conduct. In fact, in any kind of *excitement* we are less able to com-prehend a situation than we are when we are in position to confront it calmly. Emotional experience is therefore one of the great handicaps to scope or sagacity.

No careful studies have yet been made of the variation of sagacity with age. There is reason to believe that it changes in much the same way as does learning capacity. In fact, it would be strange if this were not the case, for we have already seen that the various cues in the situation can be effective only in so far as they have already been *learned* to be significant. Hence in the absence of learning ability. sagacity should be impossible; we may also surmise that the degree of sagacity depends in part upon the degree of docility. That it does not depend wholly upon this appears from the fact that individuals with similar learning ability, as measured by standard tests, may differ notoriously in scope or balance.

It seems in fact to be true that sagacity also depends to a considerable extent upon the native endowment, the constitution, the hereditary make-up of individuals. Some people are chronically "absent-minded." Any one's sagacity is impaired, of course, when he is "preoccupied" with important things. He is then likely to be "oblivious" to other things going on about him. But many individuals are chronically "preoccupied" with such trivial things that they overlook the more important considerations afforded by the environment and therefore act in strange, ineffective, unbalanced ways, which we call "neurotic." We may, in fact, say that just as the feeble-minded are those who are constitutionally deficient in docility or learning ability, so the neurotic are those who are constitutionally lacking in scope or sagacity. It will be useful at this point to become familiar with a few examples of lack of mental balance, faulty control, due to inadequate comprehension or scope for all the cues which a situation affords.

Cases of faulty mental control. To show the importance of this trait of scope or control for education and life, let us first consider a wholly imaginary case—the child whom we have described as having been taught to tip his hat upon meeting a lady. Let us suppose that this boy has a reasonable capacity for cue reduction (docility) but that he has very little scope. He will therefore be likely to be affected by some one element in a situation, to the neglect of various other elements; these other elements do not contribute effectively toward the control of his conduct.

Such a boy, if he had once learned his lesson of politeness, might find himself in a pitiable and perhaps laughable state. The mere sight of a woman would lead him to tip his hat. If the lady did not pass quickly by but paused a moment, this unsagacious boy would continue to tip his hat repeatedly so long as she remained in his field of view. If very reduced cues were effective in his case, we might find him tipping his hat even to *pictures* of women; it would be awkward for him to go through the halls of an art gallery; he would tip his hat to most of the advertisements on the billboards, and to the covers of most of the magazines. He would in fact be classified as a neurotic, afflicted with a "compulsion neurosis."

The trouble in such a case would be a lack of scope or sagacity. Alertness to other cues from the situation as a whole would be all that could save one from such a neurosis. Thus the feeling of just having tipped the hat once might prevent the act from occurring again, automatically. Sight of the frames around the pictures, of the wooden backgrounds of the billboards, would likewise introduce control, were these cues only regarded, and allowed to coöperate with the sight of the female figure.

The case as we have described it is of course a caricature; a gross exaggeration of what actually occurs. And yet the element of truth in such a picture is unmistakable, and it is just this element that, in less exaggerated form, constitutes what we call neurotic behavior. In such behavior some cue, from a past context, so overpowers the behavior of the individual, that other cues from the present situation do not have a chance to coöperate. The behavior resulting, while it might be appropriate enough to the situation in which the cue first occurred, is likely to be inappropriate to the present circumstances. It is this irrelevance that gives it its neurotic character.

Illusions, due to lack of control. Having now exhibited the neurotic picture in this imaginary caricature, let us turn to some actual cases. The first is an ordinary illusion of perception, an error of judgment that is so common that all normal people may be expected to show it. It is nevertheless due to the same lack of control that, in more extreme form, is called lack of mental balance. Compare the two horizontal lines in the accompanying figure of the "Müller-Lyer Illusion."

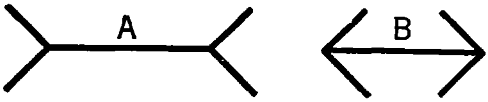

FIG. 3.—THE FAMOUS MÜLLER-LYER ILLUSION: COMPARE THE LENGTHS OF THE TWO WINGED LINES.

The lines are actually of the same length, as measurement with a ruler will show. But they do not *look* alike. The one with the outgoing wings looks longer; that with the ingoing wings looks shorter. Or if either of these is compared with a plain line, with no wings of any kind, the line with wings will look either longer or shorter, depending on the direction of the wings. Why is one misled in his estimate of the length of the horizontal line?

Many different explanations of this illusion have been offered, but all of them are the same in principle. Some *one* *feature* of the figure catches our eye, holds our attention, determines our estimate of length; other features, although there, do not make their due contribution to the estimate. Thus perhaps the white area between the sets of wings is longer or shorter; we let this simple fact have undue weight in estimating the line, although a careful scrutiny of the line itself might reveal our error. Or perhaps the outgoing wings carry the eye along, beyond the end of the horizontal line. We let the feeling of extent of eye movement have undue weight in arriving at our estimate, being relatively oblivious to other data that a more careful or sagacious com-prehension of the figure might afford.

Lack of control in the neurotic. An old story is told of a retired veteran of the wars. He was walking along the street, carrying a bundle in his arms. A practical joker, seeing him, suddenly called out "Attention!" The veteran promptly drew up in the proper military posture, his bundle dropping into the gutter, its contents scattered over the ground. The pattern of behavior here is the familiar one. The command "Attention!" was an effective cue, which had acquired its power in other situations. Because of preoccupation, or sleepiness, or emotional stress, or perhaps just because of native lack of scope, this poor veteran reacted to this cue in the light of its past context, without letting the other cues from the present situation coöperate.

In severe and clinical pictures of the neurosis we find the same pattern of behavior. A soldier, let us say, in action on the line of battle, is blown up by a shell, or terrified by the fierceness of the bombardment. He falls into a panic; his knees tremble; he stutters when he tries to call out; his heart races wildly; perhaps he falls over in a fainting spell. Such behavior is quite justified at the time, in the light of the powerful and very complex set of stimuli beating upon him from all sides.

When removed from the scene of battle, and placed in a convalescent hospital in his home country, such a soldier often continues to suffer, from what will then be called a "psychoneurosis." Sudden sounds throw him into a panic; the sight of weapons makes him tremble; the appearance of an army officer causes him to stammer violently; if several of these things occur at once, he may make all these responses in a frenzied way, and then fall over in a faint.

Observe that each of these stimuli, or causes of his inappropriate behavior, were elements in the original situation which caused his collapse. Each now tends, when it occurs, either by itself or in some other context, to lead to a collapse very like his original response to the original battle experience. But the actual *present* context of these events is very different; he is not really on the battle field; he is at home or in the hands of nurses and patient reëducators and physicians, or perhaps even back on the farm, engaged at his former occupation.

Experience shows that it is the failure of other items in the present context to have due weight in his conduct that makes the soldier neurotic. His difficulty consists in a limitation of scope, a failure of sagacity, a relative obliviousness to the attendant circumstances. Reëducation of such a person will consist chiefly in bringing it about that the stimuli become parts of new and harmless contexts, so that their coercive character, derived from the highly emotional and vivid battle experience, is given new directions. In this way the patient is enabled to "pay more attention" to the present context in which each such event occurs, and thus to make his conduct relevant to the present, not merely appropriate to some past experience. It is being overriden by his past, with inadequate scope for the present, that is the fundamental difficulty in such a case of lack of mental balance.

Phenomena of transfer in learning. This process of reacting to a given cue, presented in a new context, is a clear case of what has often been called transfer. The kind of experience aroused by one situation is now aroused also by other situations, never before met with. And such "transfer" takes place only because, in the new situation, there is at least one element which was also a part of the original situation.

Whether or not transfer of learning occurs, or to what extent it occurs, is one of the long debated questions in education. We shall have more to say about this question in a later connection. But it appears clearly enough, even at this point, not only that transfer does frequently occur, but that there are circumstances or individuals in which it may occur too freely or easily. That transfer of training occurs is one of the most obvious facts in the psychology of learning. That such transfer must often be controlled and held in check by the corrective influence of other elements in a situation is one of the most important facts of mental hygiene, and one of the fundamental principles of effective teaching.

Docility, sagacity and intelligence. The two important features of mind, which we have called docility and scope, learning capacity and sagacity, have long been recognized, although they have often been described in curious roundabout or figurative ways. Sometimes an attempt has been made to describe them physiologically, in terms of neurones and their "connections." Sometimes the picture has been drawn in terms of "instincts" and their interaction. Again "ideas" and their "associations" have been used to tell the story. We have tried simply to describe the two features in terms of the observed facts—the sequence of antecedent and consequent, stimulus and response. But whatever vocabulary be used, the important thing is that these two principles are fundamental psychological processes or facts, on the basis of which more elaborate descriptions may be based.

We may illustrate the recognition of these two principles by others by reference to one of the most recent and detailed analyses of "the nature of intelligence."[1] Thorndike, who is well known for his work in educational psychology, points out first that—

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[1] E L. Thorndike, *The Measurement of Intelligence* (Bureau of Publications, Teachers College, 1926), pp. 415*ff.*

> The gist of our doctrine is that, by original nature, the intellect capable of the highest reasoning and adaptability differs from the intellect of the imbecile only in the capacity for having more connections of the sort described. . . . The person whose intellect is greater or higher or better than that of another person differs from him in the last analysis in having . . . simply a larger number of connections of the ordinary sort.

And we are also told, before the analysis is completed, that

> there is also perhaps a capacity for having the neurones act *with reference one to another,* that is, with *integration,* whose low or negative extreme is pronounced dissociation, as in hysteria, and whose high or positive extreme appears as a notable good sense or adequacy in the use of one's experiences. This capacity may be largely irrespective of [number of connections].

Effectiveness, or if we may use the word in this way, *intelligence,* requires a reasonable degree of both these traits. The term intelligence has been used loosely and vaguely, sometimes to refer to learning ability alone, sometimes to refer to general competence, general level of mental ability. If we use the word at all, we should prefer to say that intelligence means the net mental effectiveness that comes from a suitable degree of docility operating together with an adequate scope or sagacity. Both these are components of intelligence. The lack of learning ability which the feeble-minded show is primarily a deficit in capacity for cue reduction, or learning. And lacking this, as we have seen, scope or sagacity will also be low in them. But we should also call that handicap which the neurotic shows an intelligence defect, since it interferes with normal mental control or balance.

So far as mental hygiene or the requirements for effective living are concerned, extremes of any kind appear to be undesirable. It is not so easy to show that too great a capacity for learning or cue reduction is undesirable. Yet such an undesirable extreme is conceivable. It is perhaps healthy not to be so completely impressed by every experience that *every* detail of each experience tends to arouse in us behavior appropriate to such an occasion. There are many things that it appears to be useful to forget, or even not to learn. Too great a capacity for symbolism, that is for learning, for acquiring effective cues, may result in a personality which, though less damaging, socially, than that of the feeble mind, may be more distressing to the individual. To see profound meanings in every triviality may simply mean an embarrassment of "significance," which, to say the least, would fit in poorly with the humdrum appreciation of the ordinary mortal.

In the case of scope or sagacity it appears fairly clear that too complete an alertness to every feature of any present situation may result only in paralysis of action. One does occasionally find individuals who are so impressed with the host of *considerations* that any situation involves, that the situation has passed by or has overwhelmed them before action of any effective sort emerges. The performer who is aware of every single expression of interest or apathy on the part of his audience may end up by being neither stimulated nor discouraged, but by being uncertain, vacillating, or completely inhibited. Such complete com-prehension of what is going on about one may indeed represent a larger scope, and hence a greater sagacity, in the sense in which we have used that term. But it does not make for effective public performance, for enthusiastic leadership, and perhaps not even for faithful performance of the day's drudgery. A Hamlet who sees too many sides to the case may fail to act in any effective direction.

Moderation, in other words, appears to be a good rule for mental equipment. A reasonably good degree of docility, coupled and coöperating with a reasonably broad scope, these are the characteristics of the healthy and socially effective mind.

Mental control in school activities. It will be instructive now to illustrate these two concepts, docility and scope or control by context, in the case of materials or activities closely related to the work of the school. We may find excellent examples in any of the ordinary school "subjects," and some of them will be submitted to a detailed analysis in later chapters.

For the present we may take one of the earliest and most common activities—the use and understanding of language.

As we have already seen, a printed or spoken word is a neat example of a reduced cue, a symbol that derives its power from the situations in which it has occurred. Such a symbol may lead to elaborate reactions or to complicated experiences, when it occurs on a later occasion, alone or in another context. Even slight features of such a word, such as an abbreviation of it, the first part of it, or merely the general shape of it as quickly glimpsed, may lead to appropriate response. So true is this that often we do not *really see* or *hear* all of the words that confront us; we react quickly to effective parts of them without waiting for the remainder. In the remainder there may therefore be omissions, errors, or foreign material, which go undetected. Proofreading is difficult, for one thing, just because small parts of words, greatly reduced cues or symbols, come to be as effective as the words themselves; these in turn function also for larger situations in the past experience of the actor.

Some parts of such a symbol are more effective than are others, just as some parts of the battle experience are more effective, in the case of the nervous soldier. Thus the first half of a word as seen, or the upper half of such a word, is more likely to be "meaningful" than other parts of the same word. In any situation, some cues are found to be more useful as subsequent symbols than are others. In teaching, as we shall later see, an important part of the work consists in knowing just which parts of an experience may be made into effective cues, and seeing to it that these features are present in the original.

Now for the fact of control. Just how a word will affect one may be seen very clearly to depend on the *context* in which it now appears, as well as on past contexts in which it appeared at earlier times. Thus the word "post" comes to have a meaning by virtue of having been a part of more elaborate situations in the past. The word becomes the name of, the symbol of, the more complex experience or event. But as a matter of fact this word, "post," has in a very loose way been adopted as the name for very many different situations—situations very different from each other.

"Post," for example, because of the history of its use, may mean the mail service, a wooden beam, a position of responsibility or duty, an army camp; to inform, to exhibit or announce, to put in a mail box. Some of these synonyms and the situations to which they refer are quite contradictory in character.

If then I am called upon to make some use of the word "post," or if I hear others use this word, or if I am asked to "define" it, or to "give the opposite" of it, I am at a loss, unless this word is accompanied by *other cues.* Such cues, for example, would be other words, comprising what we call the context—preceding words on the page; accompanying words in the spoken phrase, as—"post *office,*" "*hitching* post," "*army* post," "post a letter." Or the context may not be verbal at all; it may comprise the observation of other attendant circumstances, objects and relations.

The effect of the spoken word "Fire!", for example, is determined in a very complex and subtle way by the joint influence of many other items in the present context—such items as the tone in which it is spoken; the accompanying gestures of the speaker, the movements of his hands, the direction of his gaze, the expressions of his face; by previous words just spoken in this connection; by visual observation of other circumstances; as well as by the past situations in which the word "fire" has been an element. In other words, in understanding the word "fire," or in acting in response to it, there are many important elements of *control,* as well as the simple fact of *symbolism.* The symbolism comes from past contexts in which the word has been used; the control comes from the present context in which the word now occurs.

For one to be oblivious to these controlling cues from the present context would still enable the word to function, for one or other past situation; but it might function *in error;* that is, the events to which it might lead might be wholly inappropriate to the present situation. Such errors of understanding would be comparable to the unstable behavior of the neurotic soldier.

Any school subject could be used to illustrate the importance of control, along with learning. Examples from spelling are clear and can be briefly described. The child who has learned to spell the sound or "phonogram" DUK as "duck" and TR as "ter" may now be asked to spell "conductor." If led only by phonetic cues he is likely to write "conduckter." He has learned, but he lacks control. This control must be afforded by other cues, phonetic or of other kinds, in the situation.

Thus he must use "duc" for the phonetic DUK, *when preceded by "CON" and followed by TR.* And under such circumstances, that is, in such contexts, the TR must also be spelled as "tor" rather than "ter." Response to the single phonetic cue exhibits learning but leads to error. Control by *other cues* is required to enable *spelling* to occur. Thus also, whether the child is to spell the phonogram OR as "o'er," "or," "oar," "ore" or "our" must be determined not by the single phonetic cue alone, but by other cues also available in the context or setting. Absence of such control is what we mean by narrowness of scope.

Facilitation and interference. Finally we may consider a few simple examples of the very specific way in which different cues, each acting in the light of past learning, may work together (synergy, facilitation) or may work in opposite directions (interference, inhibition) when they occur simultaneously. By long training a dog learned to sit up in a "begging" position when told, "Sit up," and also in response to the raised finger of his master. He was taught to lie down in response to the words "Lie down" and also in reply to a gesture, *viz.,* patting the floor.

Observation easily showed that these various directions might thereafter reënforce or interfere with one another. When the master said, "Sit up," and also raised his finger in the air, these two compatible stimuli, or rather these two cues leading to compatible responses, to the same response in fact, were quickly effective. The two consistent cues were more effective than either one used alone. But if the master said "Sit up" and also patted on the floor, the dog would behave in curious ways. Sometimes he would begin to rise to the sitting position, only to flop down upon the floor in an awkward way. Or he would first begin to crouch and then spring awkwardly up into the sitting posture. Or he might simply halt, as if embarrassed or uncertain, wagging his tail and peering up at his master's face, or leaping up to lick his hand.

The two cues may work together; or they may effectually block one another or result in some awkward compromise; or they may merely nullify one another, thus allowing *some other cue* to have right of way and thus determine the animal's conduct.

A map for the analysis of mental control. In the preceding chapter we concluded with a simple diagram, in which was represented the analysis of the learning process into the various parts—the past context and its response, the present cue and its tendency to lead to a similar response. We need now to complicate this simple diagram in such a way as to represent the facts of control. All we need is a combination of several simple diagrams such as those used to represent the facts of learning. Such a diagram is sure to be so oversimplified as to give a false impression of the ease with which analyses of this sort may be made. Nevertheless it is an effort to make some such clear-cut analysis that will be found most useful in attacking any psychological problem.

Let us suppose that, as the result of situation *ABCD*, there ensues the response 1-2-3; and that through the technique of training, the elements of this situation (as *D* for example) will now lead to 1-2-3 when they are presented in isolation. Suppose also that in a similar way the element *H* has come to be an effective cue for a situation *EFGH*, leading therefore to a response 4-2-5.

On a later occasion the learner confronts a situation which we may represent as *DHX*. *D* is an item from situation *ABCD; H* is an item such as was formerly in situation *EFGH; X* is some other detail having no relation to either of these earlier contexts. The question now is, what might we expect the effect of stimulus *DHX* to be, in the light of our laws of learning and control?

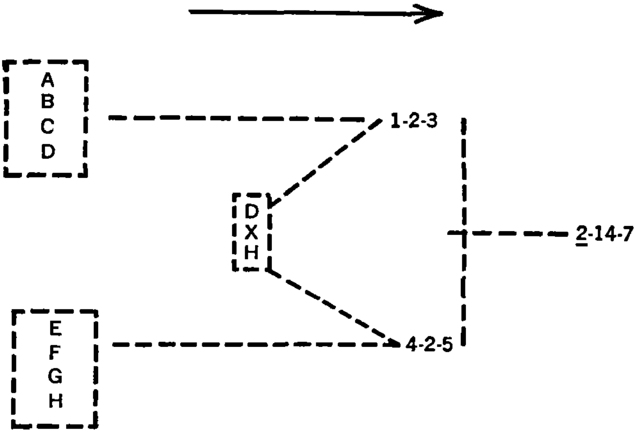

FIG. 4 —MAP FOR THE ANALYSIS OF MENTAL CONTROL.

The present situation is complex; it includes features or stimuli *DXH*. Considered separately *D* would lead to a reaction of the type 1-2-3; *H* would lead to a reaction of the 4-2-5 type. *X* is a new item; we may suppose that its contribution would be an element of behavior or experience represented by the number 7.

Now what will happen obviously depends on the compatibility of the elements of the various response patterns, and their relations of reënforcement, opposition and organization. Let us suppose that item 2 is an act that is not incompatible with other elements of these response patterns. Since it is *jointly* instigated both by *D* and by *H*, it may be expected to appear as a prompt and conspicuous feature of the total response.

Suppose that elements 1 and 4, one from each of the earlier response patterns, can both occur together, and neither is incompatible with other elements of the two patterns. Then both 1 and 4 will be expected to appear, 1 because of the action of *D*, 4 because of the action of *H*. But these items will not appear in so vigorous a fashion as 2, which is jointly aroused by both *D* and *H*.

Suppose further that items 3 and 5 are incompatible; thus 3 might be turning the head to the right, and 5 turning the head to the left. Since the head cannot be turned in both directions at the same time, we might expect that, in the simplest conceivable case at least, neither 3 nor 5 would appear; they are mutually antagonistic.

The new element *X* in the present situation may be allowed to produce its characteristic response 7, since we agreed that this might be supposed not to be incompatible with any of the other elements of the response patterns.

The outcome may then be expected to be a response pattern indicated by the numbers *2*-14-7, providing that learning has been equally effective in both the cases, and providing that the scope of the actor is sufficient to permit the free interplay of all the elements (*D, H, X*) in the present situation. Such a response pattern would be the most appropriate behavior conceivable in the face of a *DHX* situation, although such a situation as *DHX* might never before have been encountered.

For such a situation as *DHX* calls doubly for a response item of the 2 type; there is in it that which calls also for responses of the type 1, 4, 7. And the omission of both the antagonistic elements, 3 and 5, is as reasonable an outcome as such a "conflicting" situation could be expected to produce, when it occurs for the first time.

We must not make a fetish of such a diagram, nor expect to be able actually to break up human experience or human behavior into such neat parcels as those represented by our various letters and numerals. The diagram is merely a map for our guidance. Any map, say a map of North America, grossly oversimplifies the actual complexity of that enormous and variegated patch of territory. Cities are represented by dots, and many actual towns and villages are omitted. Rivers are represented by rather regular lines, of uniform width and color, although rivers are not really like that. And the tiny scratches that represent the mountains, the faded patches that represent the lakes, fall far short of the actual glories of those objects. Nevertheless, a map is a very useful guide; a photograph would be a better guide, but only a tiny section of the vast territory could be represented or pictured in this way.

The main thing to be avoided is the supposition that such diagrams as those we are employing are intended to be pictures of what we conjecture may be happening in the brain, in the nervous system, or in the social life of the neurones. No, indeed! Let physiology handle its own work, and draw its own diagrams. We are for the moment interested in educational psychology instead, and we are trying only to represent, in graphic symbols, the relations and sequences observed in the behavior and experience of men, women, children, and other creatures capable of learning.

The basis of originality. People are not doomed to mere repetitions of their past acts. Originality, initiative, invention occur. And these happen not because of some peculiar and occult power, but just because learning and sagacity (cue reduction and scope) make them possible. Consider the case we have just analyzed. Reaction 2-14-7 was original; we may suppose it had never occurred before. Situation *DXH* is a novel situation and 2-14-7 a new bit of behavior. This novel behavior occurred (*a*) because *D, X* and *H* had become, through learning, adequate cues for contexts in which they had once been parts, though never occurring together; and (*b*) because the scope of the individual was adequate to comprehend *D*, and *X* and *H* jointly, thus permitting them to combine in their effectiveness. The *resultant* of this joint action was the original or unique reaction 2-14-7.

New ideas and original behavior are possible only to those who profit from a rich experience and are alert to all or many of the cues of the present situation. Not only does this explain originality; it is in fact the only way in which original behavior could occur and at the same time be relevant. The genius is one who discerns in a situation or problem cues that most of us overlook; and these cues have meaning for him only because of past experiences in which they have occurred. Achievement that astonishes the ordinary mortal may be produced either by exceptional scope or by exceptional learning. Ordinarily it is due to both these factors; facile learning and broad or subtle scope tend to go together, although the correlation is far from perfect.

PROBLEMS

1. Point out ways in which other simple reflexes, such as pulse, breathing, digestion, are determined by the joint influence of several stimuli.
2. Show how ordinary voluntary acts, such as deciding when to cross the street in traffic, are jointly controlled by many cues.
3. Cite an instance of absent-mindedness you have observed, and analyze the situation so as to reveal the nature of the cues that dominated and those that failed to provide adequate control.
4. Can you describe an instance where a lower animal was led into ridiculous behavior because of the lack or failure of controlling stimuli?
5. Point out the striking resemblance between the behavior of the blind or deaf and those who are here described as lacking in scope or sagacity.
6. Cite occasions on which normal sagacity or control by joint stimuli was impaired by fatigue, excitement, or sleepiness. Do you know of any drugs that have a similar effect?
7. Find another familiar "illusion" and analyze it to see if it illustrates prepotency of certain partial stimuli.
8. Consider definitions of intelligence given in various psychology or education books and discover to what extent they recognize the importance of (*a*) learning, and (*b*) scope

9. Examine errors in arithmetic made by young pupils, distinguishing the part played by (*a*) inadequate learning, and (*b*) inadequate scope for all the details of the problem.

10. Analyze some actual situation according to the diagram on page 54, substituting actual items for the abstract letters there used.

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CHAPTER IV

MOTIVATION—THE DYNAMICS OF EDUCATION

Stimuli as motives. Life is activity, and mental life is no exception. Experiences follow upon their causes; reactions are responses to stimuli. In this constant streaming of events, science looks upon events earlier in the series as the causes of events following upon them. There is then something dynamic about mental life—namely, this constant course of change, one event leading to another, and thus being the stimulus to, the cause of, events which follow.

Motivation, in the broadest sense, is simply this fact of sequence. One event is the motive of another only in so far as it *leads to* that other. Even in physics, events have their motives. A wheel goes round *because* some one pushed it; the motivation of the wheel's movement is just that push, without which the wheel would not have budged. Billiard ball *A*, while rolling, strikes ball *B*, which is at rest. Ball *A* now quickly loses its motion, and ball *B* scurries across the table. The movement of *B* was motivated; the motivation of *B's* activity was the impact of ball *A* upon ball *B*. Without this, or some other effective antecedent, *B* would have remained still forever.

The point, for the moment, is that motivation is not some occult agent, which hides within the balls, or which hovers over them. Motivation is simply the observed fact that particular things happen only after certain other things happen. To be sure we sometimes say that "ball *A* communicated its energy to ball *B*." But this is only a highly abbreviated way of stating the facts actually observed. Instead of narrating in detail all the circumstances, namely that "Ball *A* was moving in a given direction at a given speed and came in contact with ball

B which was at rest and free from obstruction, whereupon ball *A* lost some or all of its motion and ball *B* began to move at a rate and in a direction which could, experimentally, be shown to be connected with the speed and direction of ball *A*," we develop convenient and sometimes highly technical abbreviations for such a speech. We use such terms as energy, mass, momentum; we write abstract formulas, in which *t* stands for time; *m* stands for momentum; *d* stands for density; *a* stands for acceleration, and so on. But if we get underneath these technical abbreviations, we find only the observed facts of motion and sequence.

The same thing is true in the case of living organisms. Without increased illumination of the retina, the pupil does not contract. Or if it does, then we find that *other* stimuli are capable of bringing about this change. *The stimulus is the motive.* And it is important to note what becomes of a stimulus, once it has acted. The very reaction to which it leads tends to demolish the stimulus. When ball *A* struck ball *B, B* was set in motion; but *A* thereupon came to rest; the more effectively *A* sets *B* going, the more quickly will *A* itself come to rest. In the case of the eye reflex, the same thing is to be observed. Increased illumination of the retina causes the pupil to contract. This very contraction of the pupil excludes some of the illumination. The reaction is calculated to eliminate the very stimulus that produced it.

Motives are always irritants. If we wish to speak in physical or semi-physical terms, we may say that a living organism, such as a child, is a complex system of stresses and strains, an energy pattern, in a condition of relative equilibrium unless *acted upon* by some change, either from without or from within the system. A change of this kind is what we mean by a stimulus, in physiological terms. The stimulus is primarily a *disturber;* it *breaks in* upon a system that is in a condition of relative equilibrium and upsets that balance.

The effect of the stimulus is to set going a redistribution of stresses and strains, to bring about changes which will eliminate the disturbance and bring the system again to a condition of relative equilibrium. The stimulus, in other words, does nothing except *work itself out*. A motive is satisfied only when it is eliminated, only when it ceases to be a stimulus, and is no longer the cause of action or disturbance.

A motive may therefore be described as an irritant; and all motivation is due to irritation. The result of such irritation is some act or adjustment which will temporarily or permanently relieve the irritation. The experience of having an irritant or stimulus which is trying to work itself out we call disagreeable, unpleasant. The disappearance of the irritant, due to some event which has effectively eliminated it, we call pleasant or agreeable. Pleasure, in other words, is a synonym for relief.

In some cases the technique of alleviating, satisfying or removing a motive or irritant seems to be reflexly provided. Thus we do not need to *learn* to adjust the size of the pupil to the intensity of the illumination. This happens, as we say, because we are built that way. It is the business of the physiologist or anatomist to undertake to show just what parts or features of our *structure* are related to this fact. But any *explanation* of the fact will be just as full of mystery as is the fact itself. Billiard balls are so built that when touched they roll. This is strange enough; they might just as easily have gone up in smoke or burst into song. And if they did, it would not be difficult to point to the physical counterpart of the smoking or the singing.

In other cases, however, the technique of alleviation, to be effective, must be *acquired through learning*. An aching tooth, for example, may lead to all sorts of wild activities. These do, to be sure, act as an "outlet" for the disturbance; but they are in the nature of things not permanently successful in eliminating the irritant. The motive persists; and so long as it persists, activity will continue. Some of these random activities, such as crying, on the part of a child, may, because of what adults have learned about crying children, lead the grown-ups to take steps that will afford relief. But this mode of relief is very indirect, and involves learning on the part of other people.

More important for education is the fact that the individual himself may, through learning, acquire for each irritant a method of action which will adequately relieve that irritant. In fact, a large part of education consists of the endeavor to assist the learner in this process. Education, as we said in the beginning, is an organized technique for reducing human misery.

Thirst, for example, is a definite irritant. Through experience each of us learns that this irritant may be eliminated, at least for the time being, by drinking. The motivation of drinking is therefore thirst. Similarly we learn that the best way to eliminate or reduce an aching tooth is by extracting it, or by having a competent dentist treat it. We learn that an itching spot at a certain point on the skin is relieved by rubbing or scratching. When we say relieved, we mean partly or wholly eliminated or destroyed.

The motives of men are therefore their irritations, their stimuli. If education finds it useful to consider motivation, it should have clearly in mind the nature of a motive and the way in which motives act. Without motives, indeed, nothing happens, and education could do nothing. We might suppose, therefore, that one of the first tasks of the educator would be to ascertain just what array of irritants, discomforts, distresses, anxieties, and sources of disturbance would be present and could be counted on in the case of those with whom he is to deal.

Motives or drives vs. incentives or cues. Up to this point we have been speaking of motives in what we called "the broadest sense," a sense which would include all the dynamic aspects of mental activity. It is common, however, to use the term "motive" in a somewhat restricted sense, and in a rough way to distinguish between *motives* and *stimuli,* or, as the distinction is sometimes put, between drives and incentives.

This distinction is based only on the fact that some irritants are either by nature brief and transient, or are by some easy technique readily and effectively eliminated. Other irritants are by nature more enduring and persistent, unless some effective technique for handling them comes to be acquired. It is the general custom to call brief and transitory irritants "stimuli" or "incentives," and to refer to the more persistent ones as "motives" or "drives." This is as a matter of fact a very convenient distinction, and to adopt it will facilitate what we have to say at a later point about the use of motives in education. We may, therefore, dwell briefly on this distinction and find a few illustrations that may assist in making it clear and useful.

A clap of thunder, for example, is a brief event. No sooner has it come than it has gone. It sets up a disturbance, which leads to a shocklike adjustment of the experience and movements of the listener, and these serve as the *outlet* for that disturbance. Nothing more is required, for the disappearance of the irritant did not depend on the adjustment made, but on the nature of thunder.

Ordinary changes in illumination are likely not to be so brief and transitory, so far as objective records are concerned. But, as we have seen, we are provided with a mechanism of adaptation, the pupillary reflex, which effectively serves to eliminate or reduce such an irritant. The pupil contracts, and the excessive illumination is relieved, so long as the pupil maintains this adjustment.

In the one case, thunder, the motive was brief because of its intrinsic nature; in the other the motive was brief because a ready technique of adjustment was at hand. In both these cases, therefore, we may speak of *stimuli* rather than of *motives*. Now it would not be difficult to transform both these irritants into *motives* in the narrower sense. Suppose that we substitute for natural thunder the artificial thunder caused by the steel riveters at work on a near-by building. Or suppose that instead of ordinary changes in illumination we produce such a bright light that the maximum contraction of which the pupil is capable does not succeed in reducing the illumination within the eyeball to a point which we can tolerate. Both these irritants now become enduring and persistent, that is, become motives in the narrower sense. They will, as persistent stimuli, continue to produce disturbances and efforts at adjustment so long as they endure; that is, so long as nothing is done to alleviate or destroy them.

Motives originating in the individual. It is of great importance for education that many of the stimuli to human action originate within the organism itself, rather than having their source in the acts of other people, or in the objects which we call the outside world. A toothache, for example, is as effective an irritant to human beings as is a clap of thunder or a beam of light, in spite of the fact that it originates within the organism itself. The whereabouts of an irritant is one of the least important things about it. All that is important is that it be an effective antecedent in producing those changes which comprise the activity of the system.

In fact, many of the most distinctive human *motives*, that is, persistent irritants, are of this sort. They are largely such facts as hunger, thirst, itching, fatigue, pain, appetites, organic states such as nausea, attitudes, cravings, worries, distressing memories, hopes and fears, wishes, longings, dreads, feelings of injustice, ambitions—worry over the future, distress over an unkind act, dread of old age or poverty, feelings of insecurity, of shame, of embarrassment, and so on endlessly.

No mystery need be made of the privacy or subjective character of these events. They are none the less real or effective because of their privacy. It is true, of course, that such a thing as a rainbow has a public character which a toothache lacks. We express this ordinarily by saying that everybody can see the rainbow, but only he whose tooth it is can feel the ache. The number of people who have access to an event, however, would appear to be of no great importance. The genuineness of a toothache depends not one whit upon the number of people who have it. To one who has it, it constitutes an effective stimulus; to one who does not have it, it does not function directly as an irritant. But the same may be said of the rainbow, or of any other fact which people may quaintly locate in the "objective world."

Educational psychology, at any rate, need not be bothered by problems of the nature of reality, of the world as a social product. We do not educate "the social mind," but individuals. It is, therefore, the facts of individual experience and behavior that most concern us. And the important fact is that among the most coercive motives of the individual learner are those experiences which we call feelings, emotions, and those objects or symbols about us which arouse in us experiences of this kind. At a later point we shall need to consider somewhat more fully the role of human emotions as the motives of conduct. For the present we must pass to another point that relates to motives of whatever kind and assists in the discrimination of them from transient stimuli, viz., the way that motives operate.

Coöperation of drives and incentives. Transient stimuli lead on the whole to brief responses, and these, as we have seen, are often nicely calculated to eliminate the stimulus. Persistent stimuli, or motives, in the narrow sense, must lead to long-continued activity. This activity, while not suited to the immediate removal of the irritant, will be likely, especially as the result of previous learning, to be of one general sort, rather than another; in one direction or field, rather than in another.

The activities set up by a toothache, for example, are likely to consist largely of movements directed toward the face and head. The activities set up by a prolonged anger are likely to be vigorous, to be on the whole aggressive, and to be in the direction of that object with which the anger is associated. The activities connected with remorse are likely to be directed toward one's own person or belongings.

The motive, in other words, brings into play a certain general set of responses, of a certain general sort and in a certain general direction; responses which on the whole may in the past have succeeded in the effective relief from such an irritant. All that the motive can account for is the occurrence of the activity and its general character and persistence. Just what acts come, from moment to moment, is likely to be due to the contributing effect of *other stimuli,* occurring from moment to moment.

The motive, that is to say, brings into readiness, or into tentative activity, a certain general set of acts, a general orientation, posture, or attitude. Within this general repertoire which is thus given advantage over other general sets of movements or other acts, particular adjustments will be touched off from time to time by transitory stimuli, not related directly to the motive.

A hunting dog, intent upon the pursuit of another animal, will serve as a simple example. So long as the prey is in sight, or in sound, or in smell, but out of reach, it constitutes a persisting stimulus. It sets up, in the animal hunting it, varied activities and changes, of a general character. We recognize the dog to be excited, rather than sleepy; he is animated, rather than at ease; it is the fore part of his body, his eyes and jaws and ears that are especially animated, not his tail; moreover his movements of locomotion are all in a given *direction,* he is after the prey. So the persistent irritant, the fleeing prey, sets up a general set or repertoire of activity which we call the attitude of attack.

But *precisely* what the dog will do from moment to moment will be determined by *transitory* stimuli encountered on the way. Coming to a fence, he crawls through it; reaching a ditch or a wall, he springs over it; grabbed at by a passer-by, he snaps at the extended hand; joined by another dog, he yelps, and so on. It is true that such a dog is likely to show limited scope for the present situation. If he injures his foot, he "pays no attention"; if his master whistles, he seems oblivious to this stimulus. He may, in fact, seriously injure himself because of the lack of sagacity which characterizes him in this moment of excitement.

Motives and cues in learning. Nevertheless it is apparent that any description of the dog's activity must take account of at least two sets of influences. First of all there is the persisting motive, the complete sight of the prey, or some partial cue which functions adequately for the prey—as the sound it makes, its odor, or perhaps even, when the trail is lost, something in the dog's own organism which acts as an effective cue for escaping prey. Certainly such "thoughts of" are seen to operate effectively in the case of higher animals, and the dog also shows a fair capacity for reacting in response to symbols.

In addition to this persistent irritant or motive, we must also recognize the transitory stimuli, which from moment to moment determine the particular acts. The motive is a *directing* stimulus; it determines the general character and the direction of subsequent events. The transient stimuli may be called *instigating* rather than *directing.* Such reactions as they may be able to lead to must in general lie within the field or in the direction prescribed by the motive.

Motive and stimulus, drive and incentive, therefore, are seen to coöperate in determining the actual course of events. This is true no matter whether they be complete objects, such as the fence, or the injury to the leg, or whether they be reduced cues or symbols, operating on the basis of past learning, such as the whistle of the master or the extended hand of the passer-by, or whatever subtle fact in the dog itself we may suppose to "represent" or "mean" the fleeing prey when it is out of sight, sound and smell, and the trail is lost.

It will be instructive at this point to look back at some of the examples cited in the chapter on the psychology of learning. Do we there find anything corresponding to this distinction between motive and stimulus? And was any evidence there presented which revealed the necessity of both kinds of dynamic influence in learning?

Consider Thorndike's account of the learning of the kitten, of the proper ways to treat fish flakes and acid-holding capsules. We were there told: "Another piece is set before it, and it repeats the examination (probably abbreviated) and the eating. And so on, *so long as it is hungry*, with abbreviation of the examination and full retention of the eating."

We have here italicized the significant words of this paragraph, for our present purpose. The "sight of the fish flake" alone, was ineffective in leading to the eating reaction. Only "*so long as it is hungry*" does the transitory stimulus have this effect. Hunger, in other words, is the persisting motive. And, rather typically, it is an event originating *within the kitten.* Moreover, it is a certain form of distress, an irritant, leading in a general way toward acts calculated to relieve it, or favoring such acts. Sight of the fish flake is a transitory or instigating stimulus, which determines just *what* shall be eaten, and *when.* Having thus eaten, that very act tends to eliminate the irritant, that is, to allay the hunger. Motive and instigating cue conspire to bring about complacency. Thereafter, the sight of the fish may still lead to *some kind* of activity, but not to eating.

Turn next to the account of learning in the case of the nursing and feeding reactions of the infant. Note the statement made in connection with the infant of twelve weeks: "In his 12th week Mrs. Moore's boy had associated the sight of his mother with food, for *when he was hungry* he would begin crying upon catching sight of her."

This does not mean of course that when not hungry the infant would pay no attention to his mother. Instead, when not hungry, it would be some other motive or persistent cue that determined just what reactions the appearance of the mother would produce. The response actually made is due to the joint influence of both persisting and instigating cues.

In the later example of code learning, as illustrated by the substitution test, we find again indications of the same general principle. It was not enough merely to put the test sheet before the child and then, sitting back, watch what he would do.

What he will do depends either upon some motive that he already has or upon some motive with which we provide him. We provide this persisting cue in what we call "the instructions." We say, "Put in each form the number that goes there." In some way or other, either as verbally repeated statement, or as represented by some visual or auditory image, or by some gesture or posture, or other symbolic cue, these "instructions" must remain effective throughout the performance. Otherwise the child will cease to put numbers in the forms and begin to do perhaps strange and futile things with them. The motive, we may say, is that slight embarrassment that comes from not yet having complied with the instructions given by one with whom one has agreed to coöperate in this way.

Description and modification of motives. The actual identification and description of the motive is often very difficult. Sometimes all we can do is to say that it was "a motive to do this rather than that." That is we do not really describe the motive, but only indicate it by stating what it leads to. This is about as precise as saying that a cow is "what occupies the barn." To those sufficiently familiar with cattle and with barns, the remark might be instructive or useful, even though far from being an adequate description.

In the case of the boy who was described as learning to play the piano, it might be very difficult to state the precise motive. In fact, in much of human behavior it is likely that *many motives* combine and interact in complex relations of facilitation and interference, just as do less persistent stimuli in the case of the knee jerk. We can perhaps, in such a case as that of the piano player, get along with some verbal indication of the way the motive may be expected to act. Thus we may say, simply in verbal terms—"He wants to reduce his feeling of inferiority to his sister by playing the piano better than she does"; or "He wants to escape the punishment threatened by his mother if he does not practice"; or "He is ashamed of the way he treated his teacher last time and wants to wipe away this feeling by being especially nice to her to-day," and so on. In any case, we should have to put our finger on some irritant or distress from which the child was seeking relief.

In the case of the shell-shocked soldier who suffered so because each transient event, such as a sound, a slap on the back, the sight of a bayonet, or the like set up in him symptoms of collapse, we have also to find a motive. We could do this in two ways. For one thing, these symptoms were more severe when the patient was in a military background; they improved when he was removed to a hospital under civilian management, and improved still more when he was sent home, away from all sorts of authority connected with military life. We may say if we like that the background stimuli, the military sights and sounds of the camp, the hospital, since they were constantly before him, tended to set up or to put in readiness or tentative execution the collapse reactions formerly experienced in connection with them. Other transitory stimuli would therefore bring into overt execution responses of this character.

Or we could say that a terrible fear persisted as part of the patient's attitude; a fear from which he could not escape; a chronic state of his organism and an inexorable direction of his attention and imagination. This persisting distress put in readiness always the general set of defense or flight reactions. Transitory stimuli, occurring from moment to moment, would thus find reactions of this type facilitated and would be more likely to produce them than to lead to responses of other kinds.

The therapeutic problem, a matter of reëducation, would in such a case become more complicated. Not only is it true that the particular stimuli that affect the patient derive their special power and effectiveness from past situations in which he collapsed and must therefore be given a different *meaning* before his condition can improve. We see also that in the patient there is a persistent stimulus or motive, which he carries about with him, and which *predisposes* him toward collapse reactions, in response to stimuli of almost any kind whatsoever. Educational reconstruction must therefore be directed not only toward relearning in connection with the transient stimuli. It must also undertake the modification of this persistent motive in the very make-up of the patient.

But the situation is no different here from that in any other educational endeavor. For educational efforts which ignore the motive and pay exclusive attention to episodic and particular stimuli will go astray. So also will those that concentrate exclusively upon the modification of motivation, without very special instruction relating to the precise stimuli to be encountered. We shall see this all more clearly when we come to the more specific applications of these general principles to the technique of instruction.

The psychology of purpose. Before leaving the topic of motivation we must consider another topic that is sometimes inexcusably confused with it—namely, the concept of *purpose* or *plan.* Thus it is sometimes loosely said that the motive of the hungry kitten is to eat; the motive of the fearful soldier is to get away from warfare. This is a hopeless confusion of the actual motive with the technique that will alleviate it. But the two things are quite different. The motive is the initial irritant that leads to activity. If the activity to which it leads is effective, that is, if it eliminates the irritant, then this effective act may be referred to as the technique. That is, it is the *proper way* to act in the face of such a motive. But the act and the motive, being different events, should not be confused or identified.

Thus the motive of a boy's activity on a particular occasion may be the prickly feeling of heat which he locates in his skin. This irritant sets up activities, and if the boy has already had considerable experience, either one or another of quite a number of alternative adjustments may be resorted to, in the light of previous learning. This particular distress may be relieved by quite a number of different techniques.

The boy may be relieved of his motive, for example, by lying immersed in the bathtub for awhile; by opening the windows; by turning on the electric fan; by going swimming; by falling asleep; by drinking cold beverages. Whichever one of these acts (determined by other cues from the present situation which reveal the feasibility of these various adjustments) the boy should adopt, it would be incorrect to refer to it as his motive. It would be instead, simply a method of relief, a technique of alleviation, a response that might have for its effect the elimination of the motive. The motive is the persistent feeling of prickly heat.

However, in individuals capable of what we call *thinking*, an act may be *contemplated* before it is actually executed. To contemplate an act is to have some plan of it, some symbolic representation of it. This symbolic plan may, in well-trained and thoughtful people, be the very first reaction to the motive. Thus the boy in question might find "in his mind's eye" a visual image of the brook and of himself standing in the water. Or he might find himself repeating the names of his favorite soda fountain beverages, dismissing each until one came to mind upon which he lingered fondly.

Any such picture, representation, or symbolic reference to an act may be called a plan of that act, a *thought* of it. When such a plan occurs in connection with a motive, the two together constitute a *purpose*. A purpose then is the symbolic representation of a mode of eliminating a motive. It is a technique of relief, a plan of salvation, tentatively mapped out and considered before its execution. Since purposes play so large a part in human life, it is important to be clear about their character. A plan without a motive is inert. But a motive without a plan is likely to be futile. A purpose requires the joint occurrence and synergy of a motive and a plan.

The reputed law of effect. Much difficulty has been introduced into the psychology of learning by a persistent confusion between "stimulus" and "response." Apparently this confusion began because some of the earlier experimental students of learning worked on the lower animals, such as chickens, cats and guinea pigs. Having put the experimental animal in the cage, they then did something to make him act. Usually this consisted in placing food somewhere in the neighborhood. This was called the stimulus. Everything that followed was called the "response" to the stimulus. Since many of the things done by the animal ceased to be done after a few trials, they called these "random responses" or "trial and error responses." The problem then arose of explaining how these "futile" or random responses were dropped, leaving only the "successful" response as the one to follow the "stimulus."

A favorite answer has been that the successful movements, or the nervous connections resulting in them, were *stamped in* by the pleasing effect produced by them; the unsuccessful movements resulted in unpleasantness and therefore were *stamped out*. But no clear account has ever been given of how pleasantness or unpleasantness can stamp things in, nor of just what was stamped in or out; nor of why feelings of this kind should act in such ways, working backward upon movements that had already occurred before the feelings came. Many other difficulties have always attended this doctrine, which has often been referred to as "the law of effect."

The fact is that these early analyses of learning began at the wrong end. We do not educate children by confronting them with problems and letting them *guess* the answer or fumble blindly until they find it. Instead we are more likely to begin with some clear notion of an act which we desire the child to do when he is placed in situations of a certain kind. This is an act which he is capable of doing, but which at first requires a very complex set of preliminaries, an extended set of stimuli.

A very young child is capable of writing his name on a check even before he has learned how to write. But before he can accomplish this, he must go through a very long series of processes, such as practicing with his pen, imitating other writing, copying words seen, writing words at dictation, and all the other things which he does in "learning to write." These are not "random responses." They are necessary steps which at first he must go through in order to get his name written on a check. And these necessary preliminary steps may take him a year or more.

Education seeks to enable the child to write his name on a check without the necessity of going each time through all these preliminary steps. It seeks to reduce the stimuli required to produce the desired result. And that is precisely what it succeeds in doing. The time finally comes, thanks to the process of cue reduction, when all that is required is the very slight cue of hearing some reliable person say, "Will you please endorse this check?"

What happens in learning is not that random responses are stamped out, but that stimuli, once necessary, are dispensed with, so that less and less of the original "exploration" is required to produce the desired act. In time, as in the case of the animal in the maze, the very first cue is adequate to lead directly to the useful act. Or, as in the case of the infant, the mere sound of the mother's voice leads to sucking or chewing movements, in general, to the feeding reaction.

The stimuli that drop out may be said to do so because they have no time to occur and need not occur. Before they have happened the first cue presented has led to the final or terminal act, and the process is brought to a close. Why should one who is learning to drive the motor car continue to look about for the pedals and continue to say to himself "First throw out the clutch," when the first glimpse of the red light has already led to the pattern of movements that effectively applies the brake?

The first stimuli that drop out are likely to be those latest in the series, just preceding the terminal act. Some of the earlier steps may all be necessary yet. As time goes on earlier and earlier steps drop out until "at the first indication" the effective act is released; the disturbance is eliminated; equilibrium has been restored.

What gives these partial stimuli or cues their effectiveness is the fact that in the beginning they were actually elements in the total situation that led to the terminal act. It is this "belongingness," not any subsequent pleasantness or unpleasantness that makes them effective.

Motivation and the law of effect. The "law of effect" seems to have gone astray partly through an unnecessary confusion between the words "effect" and "affect." As usually stated, the law is a law of "affect"—that is, a law of feeling. It is the pleasant or unpleasant "affection" that is described as operating upon the pattern of action. If this confusion be avoided, and the law stated as really a law of *effect* or *result,* there is important truth in it. The statement would then be that whether a step or act is to be preserved or not, in the course of learning, depends on what *effect,* what *consequence* it has. And such a statement definitely relates the law of effect to the topic of motivation.

As we have seen, a stimulus or motive is an irritant, a disturbance, and it leads toward adjustments that will eliminate it. Satisfaction and annoyance are closely linked to this fact. The motives to men's conduct are always annoyers; action always starts with disagreeableness, irritation, disturbance. The stimuli to the active endeavors of all creatures are mainly such things as aches, pains, itches, cramps, distresses, and other miseries. The acts to which these experiences lead are calculated, either by original nature or through learning, to *remove* or *reduce* the initial irritant. The disappearance of such an irritant—to this we give the name *pleasantness,* or *agreeableness.*

The conventional accounts of men's conduct are more likely to begin with the indication of original annoyers *and* original satisfiers, that is, of both pleasures and pains, as the effective motives. This would be like treating the clouds and the clear patches in the sky as equally fundamental and effective.

To a photographer, not interested in the dynamics of nature, but merely in its "portrayal," no doubt the clouds and the clear spaces are equally important. But to the traveler, to the farmer, to the navigator, the aviator, this is far from being the case. These all know that the clear skies are mere emptiness, so far as action is concerned. It is the clouds from whence issue consequences; it is the clouds that provide the thunder and lightning, the hail and rain.

Applying the analogy to the facts of motivation, annoyances are the clouds, the positive stimuli and sources of action. Pleasures are only the absence or disappearance or diminution of annoyance, of irritants. It is irritants that from time to time accumulate, condense, and precipitate into action of the sort that leads to learning.

The *effect* of such action, as we have seen, when it is completed, is to alleviate or nullify the irritant; and this is the result to which we apply the term "pleasantness," "satisfyingness." But the "pleasantness" is a negative fact; the positive *effect* is the *destruction of the motive,* the elimination of the irritant.

Consider the classical case of the fly on the infant's cheek. In the absence of inherited mechanisms of adjustment, this stimulus is a vague and diffusely effective irritant. Its disturbance flows out in this and that direction, determined partly by the coöperating effect of other stimuli occurring at the moment. It is a persisting irritant, a motive, a source of prolonged activity and restlessness.

The time comes when the way has been cleared for a movement that dislodges the fly; the irritant is swept away, and the activity occasioned by it now ceases. With repetition we note that this effective act, the one that will brush away the irritant, tends to come more and more promptly, and the preliminary skirmishing tends to drop gradually away. In time the very first appearance of the stimulus leads effectively to the terminal act, and adjustment has been adequately learned.

What the successful act does is to put an end to the action series for which that stimulus was responsible; it does this by eliminating the stimulus. All that precedes this terminal act we must consider its ground, its antecedent, its original stimulus or occasion. This particular action series is now over; what happens next will depend upon the nature of the next stimuli that appear.

It seems, therefore, inevitable that an irritant will ultimately, through the principle of cue reduction, become closely linked with an act that will relieve it, with the terminal relief act. Given the irritant, this act will be promptly aroused; intermediate steps, once necessary, will tend to drop out. If any of them should appear, it also, as a partial feature of the original situation, would lead strongly toward the terminal act. In this way, if earlier steps occur, there is a stronger and stronger tendency for the terminal act to be produced. Hence intermediate steps placed rather late in the series are less likely to occur, if only because the occurrence of the terminal relief act soon puts an end to the whole activity.

The psychology of motivation therefore reveals clearly the facts toward which the classical "law of affect" was vaguely groping. Learning is, in a sense, due to the *consequences* of an act, to its *effect*. The terminal act, which eliminates the initial motive, puts an end to the activity, since it was the stimulus that set this activity going. This successful act it is that completes this particular activity series. All the details of the series that preceded it will now tend, if they occur, to lead to this terminal act. This is simply the law of cue reduction, a fundamental principle that seems fairly to describe an important fact about the behavior of protoplasm, of which living creatures are composed.

The correlate of this process will be pleasantness, just as the correlate of the initial irritant was unpleasantness. These are subjective aspects of the process which we have described objectively in greater detail. Unpleasantness signifies an activity series in progress, which will continue until a terminal act is hit upon. Pleasantness (the disappearance of the cloud) indicates that such a terminal relief act has occurred. But the learning is due to neither of these two convenient signals. The learning is due to, or illustrates, the general law of cue reduction, whereby an initial irritant becomes able to lead directly to the relief act which terminates the series originally set going by that irritant.

Learning economizes action and anticipates the future. If the acts that drop out, in learning, are considered only as "random responses" to the first step, the stimulus or situation, no explanation ever offered is able to show why they should ever be omitted. But if we consider that they are most of all *stimuli* or *part-causes* of the acts that follow them, the reason they drop out becomes plain. Learning is a simple case of the tendency of living substance to conserve its energies—to get results in the most economical way.

Cue reduction, that is, learning, is a simple device for decreasing the costs of effective adjustment and of producing it earlier. The more effective the learning, the slighter is the cue required for useful action. The slighter the required cue, the greater the number of cues available, since *any* of the previous details may now suffice. The slighter the cue, the more economical of time and energy is the organism's behavior, and the earlier in a problem or difficulty will effective adjustment appear.

This result was revealed in even those very simple cases of infant learning described in Chapter II. Recall the example of the defensive reactions of the child of only eight months. As the result of cue reduction, "the defense movements . . . are directed toward an object which has *not yet begun to do any harm.*"

In this way, that *threatened* harm may even be wholly avoided. Learning is based on past experience, to be sure. But one of its results is to guarantee better and safer experiences in the future. As the result of learning, the organism is something more than a mere record of its past. It is also enabled actively to *anticipate* its future, and to a degree to determine beforehand what that future will be. The more effective the learning, the more forward-looking will be the behavior of the learner.

In the final analysis it is the *uniformity of nature* that enables learning to play this *purposive* and *anticipatory* rôle. Because of the tendency to uniformity in the processes of the natural world, the details of coming situations will be *like* the details of past situations. It is reaction to the *early* cues of coming situations that enables the individual, in the light of its past, to meet the future in ways that are adaptive, anticipatory, and purposive.

General summary. As a result of these general and preliminary chapters we have arrived at a very few principles, which are, however, fundamental to any psychological study. It is these principles which will constitute a useful basis for our subsequent analysis of the psychology of education. We may usefully bring together these principles in the form of a brief summary:

1. *The general law of cue reduction* (which merely describes a fundamental feature of the behavior of protoplasm) and the special laws relating to frequency, recency, combination of stimuli, and the like, provided by experimental psychology.

2. *The distinction between transient cues* (casual stimuli) *and enduring irritants* (motives). The former come and go with only brief reference to the behavior of the system. The latter persist longer, often until alleviated by some adjustment of the system itself.

3 *Varying degrees of scope* (sagacity) which permit corresponding degrees of com-prehension or joint action of several different cues available in a given situation.

4. *The concept of an activity series,* with its initial irritant, its intermediate steps (exploration, discovery), and its final terminal or successful act, which eliminates or reduces the irritant.

PROBLEMS

1. Make a record of the uses of the term "motive" in common speech and in your reading, and consider to what degree this term is consistently or systematically employed.

2. Take some case in which the motive does not at first appear to be an "irritant" and see if you can show what the actual distress is in such a case.

3. Can you find any instances which clearly refute the statement that motives are always distresses?

4. Cite other common experiences to illustrate the tendency of a stimulus to bring about activities which will eliminate it.

5. Analyze some familiar act of your own showing the coöperation of (*a*) persisting and (*b*) transient stimuli.

6. Observe a child busily engaged in some activity. What are the persisting motives and what the transient stimuli? Show how they jointly guide his behavior.

7. Analyze your career as a college student so as to reveal the joint action of motives and transient stimuli.

8. What precisely is the nature of the distress that leads you to continue your college education?

9. Cite other instances showing that the way a transient cue operates depends on the presence and nature of a more enduring stimulus, the motive.

10. Give examples so analyzed as to show that you clearly understand the distinction between a motive and a purpose.

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CHAPTER V

HUMAN MOTIVES AVAILABLE IN EDUCATION

Human engineering. Knowledge of the array of motives which move human beings should be useful in all the arts of management, one of which is education. Many of the activities of men are so similar in character to those of simpler forms of animal life that it may be instructive to begin with motives common to all animals. Having surveyed these we shall then be in better position to advance to the motives peculiar to human beings, and their rôle in education.

The primary questions are: What things do creatures typically do? What are the reasons, the causes, of such conduct? If it be possible to trace the conduct of living beings back to some brief list of motives or exciting causes, knowledge of these fundamental origins will be the starting point for any intelligent attempt at management or guidance.

The question in the case of human beings is sometimes put in the form—"What is the original nature of man?" This question covers not only the motives, but also matters of equipment and ability, such as we shall later consider in the chapter on "The Quality of the Organism." We are here concerned with motives only, and in the interests of education we shall include all motives of fundamental and common character, whether these be "original" or "acquired."

The vital activities. In the case of much of the behavior of living organisms, whether plant or animal, the processes are on the vegetative or physiological level. Bones grow; wounds heal; food is digested or assimilated; important substances are manufactured by the glands and distributed to the tissues; breathing and circulation are maintained. In a word, the "vital processes" seem to "run themselves"; they are nevertheless, however simple and mechanical, *activities* of the living creature. They may be described as *adjustments* to the environment.

Stimuli are required for these vital activities, even if these stimuli be mere physical or chemical changes. External stimuli, such as light and pressure, may be involved. So also are stimuli "ingested" by the organism or passed through it, as in the case of foods and poisons. Changes *within* the organism are also important—the contraction of muscles, pressure due to the growth of adjoining parts, temperature changes due to oxidation, and fatigue products produced in the course of work. Especially important are those subtle influences which we call heredity, the mechanism of which is to be found in the beginning in the minute nuclei of the germ cells which in their union start the growth processes resulting in the individual.

In physical terms these influences may be grouped together as "energy changes"—an inclusive, even if not very instructive, name. Greater instructiveness is to be found in the suggestion that these changes are *disturbances of equilibrium*, and that the acts to which they lead are devices for the *restoration* of equilibrium.

Certain structural *patterns* seem to be important. These patterns of organization are in many respects the most significant and mysterious things about life. They have been variously named. The ancients sometimes called them *ideas* or *principles*. Later they were called *forms* or *patterns*. The modern term is the German *Gestalten*, sometimes translated into English as "configurations."

The behavior of an injured finger is a familiar example. If the finger is maimed or crushed, a *healing* process sets in. Lost tissue is restored, by the growth and extension of neighboring parts. The quite remarkable thing is that the restoration takes the *shape* of a finger. Just that restoration occurs, in general, which completes the injured member, reproducing again the original pattern, form or configuration.

It is as if the original finger represented a certain balance or equilibrium, a closed *system*, an organized whole. While thus intact, its parts do not extend themselves; no activity occurs. But let an accident do *violence* to this system, let injury *disturb* the symmetrical balance or equilibrium, activity speedily ensues. The activity continues until symmetry or equilibrium is again achieved; thereupon it ceases. The activity was a response to a stimulus; this stimulus was the disturbance of a "natural" pattern of organization, balance, or equilibrium.

Animal behavior. *The reflex.* On a more advanced plane, the simpler animals exhibit varied activities in addition to these vegetative or vital processes. Numerous "reflexes" are to be described. The acts of swallowing, coughing, excretion, yawning, stretching, scratching, are familiar examples. Human beings also show such reflexes, perhaps in greater number. Crying, smiling, laughing, represent such simple acts occurring at least only in the higher vertebrates.

We have already discussed in detail the grasping reflex, the knee jerk, the pupillary reflex, and the primitive nursing reaction, and have suggested that some of these simple adjustments may really be learned activities. But there remain, even granting this, plenty of adjustments which man appears to exhibit in a reflex way.

The neurologist explains the reflex as due to a pre-established path of conduction or low resistance in the nervous system. By virtue of this conduction path, what we describe as the obvious *response* may occur at some distance in the organism from the point where the stimulus was applied.

An "energy change" is applied at one point—say the cheek is pressed. This energy change, however, we must also describe as a *disturbance of equilibrium.* Without such a disturbance no activity occurs. The preformed "pathway" through the nervous system is just a convenient and safe device for *conducting* such a disturbance away. The disturbance "flows" over the nervous pathway, each point disturbing that next to it. In some way not yet wholly understood, this *wave* of chemical, electrical, or nervous energy or disturbance passes out to specific muscles or "effectors." These, disturbed, contract, thus passing the disturbance out again upon the environment where it continues to produce its infinite chain of further disturbances.

This is the *physics* of the reflex. As we have seen, the actual physics is still obscure. But one clear point emerges. The reflex, as an act, is a method of restoring relative equilibrium to a system that has been disturbed by that energy change which we call the stimulus.

Reflexes with indirect adaptation. We have however already observed that many reflexes serve a more indirect purpose in adjustment. The pupillary reflex serves not only as an *outlet* for the disturbance caused by the bright light; the movement serves also to *adjust* the eye so as permanently to *reduce* that illumination. The cough, reflexly produced, not only serves as an *outlet* for the energy change causing it; it actually *removes* the offending object from the throat. It affords a permanent escape as well as an immediate outlet.

The neurological explanation may still be in terms of pathways. But an element of indirect adaptation or utility is here present, a new feature not apparent in reflexes that afford merely the convenient *exit* of a disturbance. The effective environment is itself changed; the illumination of the retina, for example, is reduced.

The biological problem of the *origin* of such adaptive escape or adjustment reflexes is not the immediate concern of psychology, although it is an extremely interesting topic. Our own emphasis must again be on the fact that here also activity is due to disturbance; the effect of activity is to restore the original equilibrium and to ensure its future.

These adaptive reflexes are suitably described as "protective." They preserve the integrity of this or that *organ* or structure. In the case we have cited, this organ is the eye.

Adjustments in the interest of the whole organism. More complex activities may be said to occur in the interests of the *organism as a whole,* rather than for the sake of particular *organs.* Much of the life of the lower animals is consumed by activities of this kind—seeking and eating food, defense through combat, digging burrows, escaping enemies through flight, storing or collecting supplies. We may add to this list the activities that serve the *species,* as well as, or often rather than, the individual organism. Such activities would include nest building, mating, laying eggs, incubation, feeding and nursing the young, defending them, perhaps instructing them. Many of these activities are extremely complex.

On this level the psychology of motive has usually either struck on the rock of mysticism or floundered in the shoals of words. Rather than confess ignorance, the method has commonly been to invoke *names* and to endow these names with the power of producing action. The most common names are "instinct" and "purpose." The loose use of such words is now a well-known psychological scandal. Before freeing ourselves from it, we must analyze the complex and bring the troubles into the clear light of consciousness.

The concept of instinct. The term instinct has sometimes been spelled with an initial capital and taken to be the name of some general power or faculty which enables animals to act in useful ways. Used in the plural, and without the capital "I," "the instincts" have been described and listed. For some the term (such as the fighting instinct, the mating instinct, the nest-building instinct) was the name of a certain set of movements, a definite pattern and sequence of activities supposed to be indulged in by an animal. The futility of this use of the term is shown by the fact that what an animal does, in fighting for instance, depends on a number of things. A bird fights one way, a fish another, a bumble bee still another way. Further, the fighting movements of any animal will vary with its opponent, with the geography, with age and experience, and so on. The same may be said of any of the instincts conceived as patterns of movement.

This procedure failing, others have suggested that instincts are certain "brain patterns," certain patterns of low resistance aroused or traversed by energy from certain situations or stimuli. The situations, it is conceded, may include the "inner state" of the animal (as hunger) as well as the "external stimuli." But the concept of brain patterns is only a pseudo-scientific allegory, and the actual variability of "instinctive behavior" is difficult to explain even on such an hypothesis.

Another resort has been to describe instincts as "dispositions of the soul." The soul or mind, according to this view, is an *unobservable* system, which we know about only through *inference.* It is made up of *dispositions;* these are sources of psychic energy. Aroused from their slumbers by the "experiences" of the organism, the dispositions seize upon the body and move it in effective or purposive ways. For the dispositions are also called "purposes."

According to this view, instincts and purposes, resident in the "world of mental structure," are the "prime movers of all action." Being unobservable and inferred, they appear to be identical with the mysterious "powers" and "demons" of the ancients. Certainly they are not safe assistants to be invoked in the work of the educator.

Organic distress as a substitute for instinct. Instead of following the flights of the instinct hypothesis, it seems more useful for education to extend the concept of *motive* to which we were led in the case of outlets and protective reflexes. Action was there found to be the result of disturbance, stress, or upset of equilibrium. We may suppose that the so-called instinctive acts are also responses to some mental or bodily distress, to some irritant, which produces restlessness and activity until it is relieved. The particular activities engaged in will be those which, through the make-up of the animal or through the process of learning, serve as well as they do to allay the initial distress or motive.

As to just what these irritants are, in the lower animals, our ignorance is profound. It seems better to admit this ignorance than to conceal it with words. In a few cases some suggestions are available. Thus it appears that the nest-building of rats varies with and depends on the animal's temperature. Many activities (such as incubation) may depend on similar simple conditions. We can at present only guess their nature and surmise that the effect of the activities is to *relieve* the initial disturbance.

Why the activities take the forms they do; how such activities allay their initial stimuli; how much of the useful activity is "unlearned"; what the basis of an unlearned act may be; in just what way such acts come to serve also the biological needs of the species (as in mating); all these remain open questions. Until we know something in detail about the way the injured finger restores its tissue and shape; the way the embryo develops in the astonishing way it does; what the mechanism of heredity is; how the cells of the body convert inert substance into living tissue; we need not expect to be able to throw much light on these presumably more complex processes of adaptation.

We can, however, observe that the way an animal will act in response to any stimulus will depend in part on the animal's structure. Fish, when stimulated, can only swim away; worms can but crawl; but birds can fly or sing and dogs can either run, snarl, or attack. Man's repertoire is still greater. He can crawl or run, cry or swear, slander or signal a policeman, or change his vote at the next election.

We can moreover carry the one result of our analysis, the fact that motives are always distresses, forward to the more easily observable field of human activity. It is this field in which the problem of motivation most concerns the educator.

Instincts in human psychology. In the case of human conduct the instinct concepts have been applied in all the ways we have indicated. None of the concepts has been generally satisfactory. In reply to the question, "What do human beings instinctively do?", the answers have varied from authority to authority, from epoch to epoch. One reason for this may be found in the remarkable learning capacity of the human being. Learned adjustments, from the very beginning, so overlie whatever "native" action tendencies there are that it appears impossible to distinguish between them.

The favorite criterion of "unlearned," as distinguishing the instincts, falls down if such simple behavior as nursing and grasping may be shown to be learned acts. The criterion of "universality" may refer only to the uniform conditions under which the earliest learning takes place. Whatever the case with lower animals, the activities of men are so determined by their social heredity, by the instruments, the institutions, the conventions of their man-made world that no one can say what their behavior would be aside from these influences. Observation of infants is of little aid in determining what is "native." Beards and wisdom teeth do not appear in infancy, yet they can scarcely be attributed to environment and training.

Since activity begins always with disturbance, with a distress, an annoyance or irritant, we can better inquire, "What are the fundamental annoyances of human beings?" What are the primary modes of distress from which man seeks relief through action? For whatever the idealists may say, it is only through distress that man learns. The life of mankind, as the prophets well knew, is one long struggle for deliverance, for salvation.

If we can indicate with reasonable correctness at least a sample list of the fundamental human annoyances, these and others like them will provide the educator with what he needs to know about the "springs of action" that may be looked for in the learner, and that may be counted on to *drive* the learning process.

We must, therefore, distinguish clearly between the distresses from which human beings seek relief and the methods or techniques they employ in the process. For example, instead of describing a "food-seeking instinct," we should point to "hunger" as a definite distress. It was preoccupation with *responses* that blinded the old psychology to the significant fact of cue reduction as the mechanism of learning. So also it has been preoccupation with *movements* and action patterns, rather than with irritants, that has confused the psychology of motivation.

Dominant human urges. The distress or motive may be called an urge or drive, for the striking thing about it is its impulsiveness, its leading to activity. What can be said about the fundamental human urges, the primary modes of human distress?

We may first indicate a very primitive array of motives, which arise from the needs of the bodily tissues. Among the most obvious are those resulting from lack of substances or conditions favorable for bodily growth, recuperation and health, or from the presence of conditions detrimental to these processes.

Hunger
Thirst
Fatigue
Suffocation
Sleepiness
Bodily pain
Strain
Congestion
Constipation
Delayed excretion
Indigestion
Nausea
Fever
Excessive cold or heat
Overloading of muscles

Closely related, and perhaps belonging in the same general group, are certain forms of stimulation, such as:

Monotonous stimulation
Overstimulation
Understimulation
Abrupt changes of stimulation
Certain qualities of stimulation, as bitter, sour, itch, tickle, and obnoxious odors

All of these represent motives from which we seek relief. Sometimes the names refer to objective conditions, observable by others (overloading, excessive stimulation). Some of the names indicate experiences that can be described only by the subject (itch, bitter). In still other cases the name may refer to bodily conditions and also to correlated subjective experience. Thus "hunger" may mean either the malnutrition of the tissues or the peculiar "pang" known only to the hungry man.

Psychology must include both these aspects, the objective (behavioristic) and the subjective (introspective). Both are of importance in education; a motive may be effective without the actor's being able to describe it or know its presence. This is what is meant by the influence of "unconscious" motives. Or the actor may know only the subjective aspect (as in pain) without being able to describe the objective basis of that experience. In such a case the motive might be described as "half-conscious."

That human beings, afflicted with such distresses as these, become restless and struggle as best they may until the irritant is relieved, is obvious. That the things they will do will vary with age, training, information, resources, and circumstances is equally obvious. What the acts will be, is uncertain, but the nature of the motives is clear enough. It is on this fact that the psychology of motivation must be based.

Education has harnessed some of these primitive irritants to the act of learning. More than once pupils have struggled to master the lesson in order to escape from hunger, pain, pinching, and other forms of excessive stimulation administered by the pedagogue or parent. In experiments on the learning of lower animals it is such motives that have often been most relied on to get the animal to act, and hence to learn.

Indeed many of the sustained labors of human adults represent the effort to escape from the tortures of hunger, thirst, cold, pain and filth. The vocational motive derives part of its force from the fact that "the job" is a human technique for rescuing one from the annoyance of tissue needs and baneful stimulation.

In the case of young pupils in our civilized life little use can be made of these motives in any direct way. We *spare* the child most of these distresses by our own beneficent provisions and thus relieve ourselves from the distress of seeing him suffer them. Outside of frontier conditions, the main use of such motives permitted the teacher is that of arousing the *thought* of such distresses in later life. Bodily needs, thus thought of, may also constitute effective motives in those who have had sufficient experience with the original.

Distresses of this bodily sort often serve also to interrupt learning activities by arousing restlessness and activity in other directions; it is part of the teacher's task to see that distracting motives do not provide such obstruction.

If bodily needs are accompanied by an image, a memory, the name, or some other "thought" of an object that might remove them, the experience is called a "craving," a longing or wish. If accompanied by some definite plan of action, not yet undertaken, the experience becomes a purpose, an intention or aim.

Distress arising from insults to the self. The motives just discussed might be called insults to the body. Human beings also suffer from insults to the self. Under the ordinary protected conditions of physical existence it is just these affronts to the individual's conception of himself as a person, rather than as an organism, that motivate the greater part of our conduct. Each develops a picture of himself as a certain kind of person, with certain qualities, rights, privileges and duties. These conceptions begin early in life, and with the intelligent they become very complex and easily disturbed. The following typical examples may be cited:

1. Situations are distressing that induce humility and shame, which lower the status of the self as observed below its status as conceived or expected.
2. Situations are distressing that put the individual at a disadvantage as compared with others of his class.
3. Situations that interfere with, obstruct, or frustrate the habitual or spontaneously initiated activities of the self are resented.
4. We resent acts and circumstances that seem to infringe upon the recognized or supposed rights and privileges of the self.
5. The spectacle of other selves being given greater privileges, or enjoying greater freedom or resources, is disagreeable.
6. We rebel at dictation of the self by other selves, even under circumstances logically justifiable.
7. We resent acts and remarks by others that show a discrepancy

between the self as pictured and the self as apparently conceived by others.

8. We are annoyed by loss of functions, resources, and privileges long considered as identified with the self.
9. Threats or dangers directed against the freedom, the persistence or the security of the self are dreaded.
10. We dislike to have the self ignored by others, even if there is no active aggression or threat.
11. Uncertainty or conflict in one's own concept of himself is painful.
12. Threat or danger to others who hold the self in high esteem or have contributed toward its well being is also distressing.

These sample situations will be readily recognized as strong irritants in human conduct. Examples from the activities of children and adults can easily be thought of in connection with each, and various other distresses in the career of the self may be added to the list.

Distresses of this character are particularly keen in children, who are still struggling to secure a clear notion of the self and its place in life. Roundabout and indirect means of self-relief are not yet well learned in the early years, and the general level of impotence, in the presence of adults and organized social agencies, gives additional acuteness to insults to the self.

Educational procedures that assist the child in forming a sound basis of self-estimate and a technique of self-defense, an attitude of confidence within the limits justified by the facts, are to be recommended.

Distresses with a social basis. Many, if not most, of the irritants connected with the self relate also to the presence and behavior of others of our kind. The status of the self is largely a social status, a relative status, in comparison with and in the eyes of others.

Being ignored by others is a profound distress; it may be relieved by various techniques for securing recognition—temper tantrums, hysterical illness, negativism, winning prizes and honors, public acclaim, newspaper notoriety, favorable book reviews, and a thousand other techniques. In a more roundabout way relief may be sought by denying the importance of others, privately or publicly belittling their acts, subjectively magnifying the quality or excellence of one's own achievements or traits.

The mere absence of others of our kind may also be a source of distress. Loneliness is the name given to it, and the acts to which it leads are those of "gregariousness." Finding others, remaining in their presence, these are techniques of alleviating the distress. In young and bright children "imaginary companions" are a subjective means of securing such relief.

Being displaced by others in the affection, esteem and allegiance of the group is also distressing. The first child of a family may suffer from this irritant when other children appear. The repudiated leader, the losing candidate, the advocate of abandoned doctrines, the past champion are other examples.

Distresses due to thought and sympathy. Because of the human capacity for learning, signs and symbols of distress become capable of arousing distress in us. The *prospect* of a loss, of hunger, of humiliation, of danger, may be a potent determiner of action. In such cases the action will be directed either toward removing those signs, or toward preventing the distresses they signify.

Pictured wants, anticipated fears, ideas of pain, are in fact among the most potent causes of human agony. We have already seen (in Chapter II) how the vigorous defense movements of the infant are aroused by the mere sight of the approaching cotton swab once used in a painful operation. The infant, we said, reacts to a distress that has not yet occurred. But this is not quite the case, for the distress aroused by such a sign or symbol is itself a genuine distress. To overlook this is to fail to understand the motivation of much of human conduct. Because symbols of distress, signs or partial features of painful situations may themselves become dreadful, we are aroused by verbal and pictorial portrayal of anguish. In this way also our memories, our fancies, our imaginations and anticipations become strong motives in determining our conduct.

This is also the basis of sympathetic distress. We are annoyed by the irritations of others and seek to relieve them. We "rejoice with them that do rejoice and weep with them that weep." This tends to be true only in so far as, on the basis of our own immediate or vicarious experience, the behavior of others serves as a sign or symbol. The frightened scream of a fellow creature as a cue or partial feature of danger situations arouses in us also a genuine alarm. It is this fact, that the distress of others also arouses a personal distress, that is the basis for the activities of benevolence, philanthropy and altruism.

Two general modes of relief. In these examples we have already met with two distinct modes of relief. In the one, activity is directed outwardly, that is, upon the environment, toward the source of the irritation, the situation responsible for the distress. In the other, adjustment is subjective, rather than objective. The solution occurs in fancy only; some reinterpretation of things is given which puts the situation in a new light and thus preserves the felt status of the self for the time being.

Humiliation by playmates, for example, may be met by overt and aggressive attack; retaliation may be attempted; or some positive achievement may be undertaken which will lead to a reversal of the social attitude. Any of these would be objective, outward-going adjustment. "Extroversion" is a term often used to describe such techniques of relief.

On the other hand, humiliation may be met by subjective adjustments. Sulking, and refusal to coöperate would be in this direction. Still more subjective would be retreat to solitude and occupation with "imaginary companions," who accord one greater respect. More subjective still would be flight into daydreams or into more elaborate delusions, in which phantasied prestige took the place of that denied or so reluctantly given in the real world. "Introversion" is the term used to indicate adjustments of this mode.

On the plane of the simpler bodily distresses the merits of these modes of adjustment are clearly enough seen. The effort to relieve hunger or thirst by imaginary drink or phantasied banquets would result in disaster. On the other hand, some amount of reflection, some degree of planning, of preliminary and symbolic rehearsal and consideration of alternative means or instruments would be useful. Immediate, overt seizure of the first foods and drinks observed would, in ordinary human life, be as futile or inappropriate as phantasy. Apparently some moderate balance of the two modes of adjustment, some golden mean of introversion and extroversion is to be recommended.

The same thing may be said of effective adjustment to distresses on the personal, social and sympathetic plane. A moderate capacity for cue reduction and a reasonable but not infinite scope or sagacity we have seen to be the basis of effective intelligence. A similar, moderate balance of introversion and extroversion appears also to be the most favorable mode of adjustment to human distress.

Emotion and instinct in human adjustment. An old suggestion, made by William James, was that when disturbance leads to activities effectively directed outward, so as to modify the stimulus, they should be given the name "instinct." If, instead, the adjustments made were restricted to the interior of the organism, producing upset and turmoil within the system, they should be given the name "emotion."

We have found it unprofitable to adopt the instinct hypothesis; what shall we say of emotions? The description and classification of human emotions has been as futile as the cataloguing of instincts. Emotions appear to be just those various conditions of stress which we have described as the fundamental motives. Any disturbance, upset, or collapse of the established equilibrium of mind or body is emotional. Woodworth uses the happy term "commotional," which aptly suggests this fact of disturbance. Especially if ready paths of *outlet* are not provided, we have then the persisting irritant or motive, which is appropriately called the e-motion.

But to name all the distresses men experience is as impossible as to catalogue all the acts of which they are capable or all the combinations of sounds they can utter. The total pattern is always complex. It includes the particular situation or stimulus which "breaks in" upon the system. It includes all the changes internal to the organism, and all the disturbances of consciousness. It includes also the overt or fancied techniques of adjustment, and subsequent changes in the situation, in the organic state and in subjective experience. No one of these taken singly can serve as the criterion of an emotion or justify the application of a fixed name.

A sample list of man's original activities or fundamental adjustments. For convenience of comparison and as a suggestion of the useful method of analysis, a somewhat traditional list of human distresses and the general types of activity to which they ordinarily lead is here given. The educator may make a rough "engineering" use of such a list in two ways. He may attempt to take advantage of the presence of such distresses as the driving motives of the activities in which learning may occur. And he may better understand the conduct and management of his pupils by trying to interpret both their tractable and their refractory behavior in terms of such motives.

The very brevity of such a list as this gives a certain air of absurdity to it. The facts are so much more complex than the list, and the actual motivation at any moment is so complex a synthesis of many of these and other forms of distress, that both columns of the table are wholly inadequate. But such a list is more instructive than the conventional lists of emotions and instincts. Such a list serves to indicate a method of analysis and investigation that can usefully be adopted in connection with any concrete problem of human motivation in education or in other fields.

PRIMARY DISTRESS	TYPICAL BEHAVIOR TO WHICH SUCH DISTRESS LEADS
Tissue needs, appetite, sensory deprivation	To gratify and exercise the senses in appropriate ways for so long a time as the distress endures or until relief is thought likely
Bodily discomfort, restlessness, strain, fatigue	To avoid by flight, by removal of the stimulus or by learned techniques of alleviation
Threats to those closely associated with us	Acts of devotion or protection calculated to avert the real or threatened danger
Monotony, inactivity and boredom	To work off superfluous energy in play or banter so long as relief continues
Sexual wants and cravings of the reproductive system	Definite responses toward the other sex or toward particular members in whose characteristics or acts we find relief
Danger, fear, apprehension	Retractile reactions calculated to avoid the situation or steps to modify it
Insecurity, thought of want or lack of necessities and conveniences	Accumulation, collection and storing of objects or of means for their production and purchase; thrift; bargaining; industry
Loneliness, home-sickness, want of aid or support	Seeking others, gregarious acts, establishing families, homes, and social groups
Jealousy and envy of others more fortunately situated or endowed	Competition, rivalry, efforts to dominate, to detract, slander or overthrow
Ignorance, curiosity	Examination, exploration, science and the search for knowledge
Bashfulness, shyness, embarrassment	Avoidance of inducing situations, confused and introverted activities
Nakedness, shame, feelings of low worth	Decoration and exhibition of person and belongings or attainments
Resentment, anger, petulance	Aggression by overt attack or otherwise against persons and situations blamed
Presence of dirt, filth, and obnoxious substance or conditions	Cleansing and purifying activities, overt or symbolic

Primary Distress	Typical Behavior to Which Such Distress Leads
Awe, confrontation by hopelessly superior persons and powers	Acts of reverence, obeisance and worship with elements of placation
Disorder, irregularity and faulty arrangement	Constructive activity, building, inventing and making order
Spectacle of others suffering from distresses known or experienced	Activities calculated to relieve both their and our suffering
Suspicion, dread of discovery, need of secrecy	Strategy, circumvention, efforts to deceive .or camouflage the facts
Uncertainty as to status or security of self and of its social esteem	Favoring our own work, possessions and abilities, boasting, exhibitionism, and derogatory statements and acts relating to others
Dependence upon another for outcome of our fate	Acts of gratitude and well-disposed behavior toward the sources of our relief
Suspense, pent-up excitement or stress	Outbursts of laughter, hilarity and other expressive movements and acts
Ugliness, discord and lack of harmony in surroundings	Decorative arrangement and disposition of materials provocative of relief (production of beauty)
The thought or representation of any of these distresses as imminent or probable	Appropriate acts, varying with the nature of the represented distress

The relative strength of motives. The practical problem of knowing the relative strength of various human motives is not yet capable of being solved in detail, except by experimental investigation in particular situations. The effectiveness of one motive varies with the individual, with the circumstances, with the length of time it has operated, with the influence of learning, with the presence of other motives, and so on. Representative studies may be cited to show the nature of the problem, which must in each case be solved in the circumstances to which the answer is to be applied.

Maller[1] tried to measure the relative strength of the motives of "coöperation" and "self-interest" with school children working at simple addition. Control tests were made, working just "for practice." Two kinds of contests were then arranged. In one, prizes were offered for individual speed records, and personal recognition of success was given. In the other, groups competed, the prize going to the group and no recognition of individual achievement being given.

Under individual competition the pupils worked nearly twice as fast as under the motive of group competition, and the speed was longer sustained. Three-fourths of the preferences, expressed at the end of the experiment, were for individual competition.

Still more interesting were the individual differences found among the pupils. The difference between the effect of the group motive and that of the individual motive was used as a measure of coöperativeness. No conspicuous differences with age or sex were found. But those of high and low intelligence were less coöperative than were pupils of average intelligence. Coöperativeness was greatest when the group was relatively homogeneous in ability; heterogeneity made for individualism. Individual competitiveness was also greatest among the able pupils—those capable of rapid work, with good health history, and high ratings for deportment, character, honesty and control. Inferior performers were more strongly inclined to coöperativeness, in which individual scores were submerged under cover of group achievement.

The investigator surmises that the strong individualism or competitiveness here found was perhaps due to the emphasis placed on individual achievement in the school system. On the other hand the failure to find this trait to correlate with age would suggest that the length of time the individual had been submitted to the school influence had little to do with this trait, which might well enough be due instead to an early recognition of the poverty of this world's goods and the unreliability of dependence on others.

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[1] J. B. Maller, *Coöperation and Competition,* Contributions to Education, No. 384 (Teachers College, Columbia University, 1929).

Many of the studies related to the measurement of motivation have been instead studies of "incentives." Incentives are the devices or stimuli applied by the experimenter, and they do not describe the motives operating in the learner. Thus in a later chapter a comparative study of approval and disapproval will be described, in which approval was found to be a stronger incentive than disapproval. But in neither case do we have a clear picture of the precise motive or distress relieved either by the experimenter's words or by the action of the learner.

Similar studies of the relative values of reward and punishment have been reported. Considered merely as studies of these two types of incentive, that is, types of verbal or other device to be employed by the experimenter, such studies have an empirical value. They do not, however, reveal anything concerning the relative strength of motives. If our account of motivation is correct, reward can consist only in the relief from some distress; but the description of the reward does not necessarily reveal the nature of the distress which it relieves.

The old instinct psychology described the instincts as developing in some serial fashion, as having periods of maturation when they were more active, as being transient and fading if not exercised, and so on. The element of truth in statements of this kind is to be found in the fact that individual distresses do vary with age, with circumstance, with experience, and numerous other variables. The variation is so great that no summary table of motive strengths can be given. Only a close familiarity with the facts of developmental psychology can acquaint the teacher with these variations and relationships, hence child study has long been recognized as an important part of the training of teachers.

Practical applications. When conduct calls for explanation and understanding, do not begin by asking what *instinct* or what occult *purpose* is moving the individual. Discover the nature of the distress which the activity is relieving. Once this is discovered, the reëducation of conduct and the modification of motives may be intelligently undertaken.

When specific conduct is desired, first ascertain what irritants or distresses, what stimuli and in what combination, will lead effectively to this act. Having chosen one or more appropriate motives and applied them, the act may then be trained to follow upon reduced cues, upon subtle and preliminary signs of such distress.

In conclusion we may reply briefly to a question that has been troubling the reader throughout this discussion. Are there then no positive *pleasure-seeking* tendencies? Are no acts pursued for their intrinsic joy, without reference to any distress relieved by them? The answer is emphatically: "No." Joy is relief from threatened calamity. Exultation is deliverance from defeat. Mirth is escape from suspended tension. Happiness is freedom from irritants. As for love, it was long ago defined as that which "casteth out all fear."

Human beings have impulses, certainly. But impulses are not generated in the void; they have their causes, their stimuli; and these stimuli are disturbances, distresses, irritants. We may act without expressly recognizing the irritant that prompts us. We often act, and derive pleasure in the doing, on the basis of irritants so subtle or so complex that their nature may not easily be discovered. Acts that give "esthetic pleasure" belong in this class. The precise nature of the simple sensory or perceptual distresses to which esthetic objects minister can often not be indicated. Often mere inactivity on the part of a well-developed structure or function is a distress which activity relieves.

We also act on occasion with clearly stated or imaged pictures of the nature and outcome of the act, or with some distinct representation of the change to be produced by it. We may in the meantime know that at the end pleasure will accrue. But such a plan should not be confused with the motive. In fact the very picturing of a pleasure that one does not yet have declares a lack, a want, a need, and hence a form of distress. It is this distress that leads to the act, not the non-existent pleasure, and not the plan of the act which is formulated.

PROBLEMS

1. Consult standard texts of general psychology to see how they define an instinct, or an instinctive act.
2. Consider the lists of "human instincts" given by these books. How do they impress you?
3. Cite physical examples of the tendency of a system or structure to revert to a condition of symmetry or equilibrium after disturbance.
4. Just what is meant by the statement that "the actual physics of the reflex is still obscure"?
5. Find examples in general reading or conversation to show the loose way in which the terms "instinct" and "instinctive" are used.
6. Would "instincts of greed, envy, jealousy, collecting and fighting" appear in creatures born into a world where every commodity was present in superabundance and could be secured by any person at the mere expression of a wish? How does your answer bear on the concept of instinct?
7. Enumerate several other "bodily distresses" not listed in the text, that serve as stimuli until action eliminates them.
8. What distresses may an economics teacher use in motivating students of that subject? A teacher of history? Of psychology?
9. Cite some case in your own experience in which the motive of behavior was some insult to the self. Some case in which the motive might be said to be "unconscious."
10. Find in the literature descriptions of introvert and extrovert behavior. How easily can you observe such differences in the behavior of children? How easily can you classify your friends as introvert or extrovert?

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CHAPTER VI

THE QUALITY OF THE ORGANISM; THE LEARNER

The analysis of human traits. Among the foundation topics we have now considered the nature of learning, the character and operation of motives, and the fact and importance of scope or control in all activity. Equally fundamental for education are the facts of individual differences. The traits or characteristics of the individual learner will have much to do in determining the direction and the method of education. The traits of the learner will vary with such factors as age or maturity, previous learning, constitutional or hereditary differences. The planning and conduct of instruction should very early take account of the individual traits and aptitudes, interests and dispositions, which the learner brings into the situation.

Accurate discussion of the learner requires some measurement of his characteristics. The traits of a human being are not different bits which fit together to make him. We might without great error speak of a creature as composed of oxygen, carbon, and other substances. Or we might reasonably describe it as composed of eyes, arms, legs and other organs. But even such statements would be misleading. We should have left out that very important factor, the form or organization, the pattern, without which the total would not even be a living thing.

In the case of psychological traits the difficulty is even greater. Many such traits must be thought of as features of the whole person, just as physical traits like shape, vitality and age are traits of the organism. They are not *parts* of the individual, but functions or attributes of the whole. Especially they are functions of the individual *in action.*

Individuals do differ from one another in numerous ways. We can often give names to these differences, classify and measure them, without knowing much about what the traits actually are, or on just what they depend. In this way men measure electricity, time, and perhaps even beauty, without being able to say much more about them than the measurements reveal. Nevertheless it is a great advantage to be able to describe as well as to measure any trait that we wish to talk about.

In the present state of our knowledge it is often safest to state precisely what was measured and how the measurement was made, in ways that will enable others to repeat the observations. Whatever was measured may, for the time being, be considered the "trait." When a man stands erect on the floor, we can measure the distance from the floor to the top of his head, and call this his "standing height" or "stature." This enables others to identify and to repeat our measures, no matter how puzzled philosophers may be about the exact nature of "extension in space."

For convenience, single terms such as grip, lung capacity, tapping rate, and the like may be used to indicate briefly the nature of the measurements made. In psychology the names of various "tests" are often used in the same way. To understand them fully one must be familiar with the methods and instruments of "mental measurement."

For example the rate at which an individual can perform the substitution test shown on page 19 might be called a trait—such as "substitution." It would of course be important to know just which of many substitution tests was used, and what the conditions of the test were. But this is true in all kinds of measurement.

The number of digits (such as 4-7-2-6-3) which a person can repeat immediately after hearing them spoken before him at a specified rate might be called a trait—such as "digit span." The speed or accuracy with which he can cancel from a certain printed page all of the "A's" might be called a trait—

such as "cancellation ability," or still more accurately, "ability to cancel A's."

Performances similar in general character, such as all kinds of cancellation, or a great variety of substitution tasks, or a number of span achievements, might be referred to by group names, such as sensori-motor reaction, code learning, or memory span. The problem of discovering just which performances may justly be grouped in this way, under single names, is a complex one, and it is the chief occupation of one branch of "differential" psychology. It often involves elaborate statistical methods.

As a starting point, it is enough to see that nearly any act can be measured in some respect, such as speed, accuracy, or quality, using whatever units are available in each case. But this would result in a hodgepodge of measures, some in terms of seconds, others in number of errors, others in inches, or pounds or points of merit, or what not.

The comparison of different measures. Any respect in which people differ may therefore be called a "trait," and it is often desirable to compare traits with one another, to study the individual's ability in different traits. Since the "raw measures" of these different traits may be in different units (height in inches, substitution learning in seconds, and so on) comparison can be made only after the different measures have been given some comparable basis.

Many different ways of finding comparable units for different traits are available. The most accurate methods require that a large number of individuals, of the same age, or class, be measured in each trait. Then all the individuals may be ranked in order of ability in each trait. Each individual will thus be given a certain rank or "standing" in each trait. Comparison of these ranks will show whether any given individual stands higher in some traits than in others.

Statistical methods make it possible to state differences of standing or rank in still more precise ways. Thus the middle or average individual of the group may be taken as a standard, and it may be shown how far any given person falls below or exceeds this standard.

A less precise method is much used in educational psychology. This resembles methods of measuring distance, rainfall, and the like in early times, before exact instruments had been invented, and when everybody traveled in much the same way, at a rate determined largely by his own physical energy. It was then common to describe a distance as "so many days' travel" or "so many minutes' walking." Rainfall would be described by the number of days and nights the downpour continued.

Such measures or descriptions involve the assumption that some process is going on at a fairly uniform rate, such as walking or raining. In the case of human traits the "rate of growth" has been found to serve such a purpose, and to constitute a useful, even if not a precise basis for the comparison of different traits and different people, at least during the period of growth.

Suppose that numbers of children of different ages have been measured in some trait, and we find that the trait increases in a definite way with advancing age. If other traits also behave in this way we can compare an individual's standing in two or more traits, even such diverse traits as stature and learning ability.

In the following table are given actual results of this kind. The average height of boys, from age 8 to 18, is given in centimeters. Their scores in a substitution test, for the same ages, are given in items done in a fixed time. These are averages of large numbers of boys at each age.

Trait	Years										
	8	9	10	11	12	13	14	15	16	17	18
Stature	121	126	131	135	140	146	152	158	164	168	171
Substitution	12	15	17	18	21	23	24	25	26	27	28

On the basis of such data it is possible to compare different traits in the following way. Suppose that a given boy, John, is 158 centimeters tall and makes a substitution score of 18 items. With these measures in mind we now refer to the table of standards or "norms." John has the stature of a 15-year-old boy (158 cm.); he makes the substitution score of an 11-year-old boy (18 items). *Developmentally* John is more advanced in stature than in substitution; he may be said to have developmental ages of 15 and 11 years in these two respects or traits.

All the methods we have referred to require that large numbers of comparable individuals be measured before much is said about the traits of any one. In the last case, the method of developmental age units, it is necessary to have examined large numbers of *growing* individuals, at a great many different ages or stages of development.

This method is very instructive. It calls for a careful study of children throughout the usual ages of school attendance; it results in a considerable knowledge of the general laws of mental development. Traits are thus conceived as the result of growth (maturation) and training (learning). The use and understanding of the method requires some previous knowledge of the laws of mental development. Before proceeding further with our account of the quality of the organism we shall give a brief survey of some of the facts and laws of growth.

Changes that occur in development. In the development of the human being, from the beginning to the end, changes of many kinds take place. *Heredity* and *experience,* working always together, may be said to be responsible for these changes. By heredity we mean all those influences that are present in the germ cells which, by combination, produce the individual. Experience represents the interaction of the individual with his environment, or of some parts of the individual with the environment of those parts. Such changes, when due to heredity plus innumerable and subtle environmental factors of the nature of which we know little. are called *maturation.*

In addition to these changes there are those due to *training;* these represent the coöperation of heredity with environmental factors the nature of which we can more readily know and measure.

The chief varieties of change observed in development[1] are the following:

(*a*) *Changes in magnitude:* Organs increase in size, and various functions increase in power. Changes in the opposite direction also occur—organs or functions decrease in magnitude. Up to a certain point for example the individual increases in weight; beyond this maximum he may then gradually decrease in weight. Both these changes are parts of development.

(*b*) *Changes in pattern and proportion:* Organs, powers and interests once prominent become less conspicuous, while others become emphasized. The photograph of an adult by no means looks just like the enlarged photograph of a child. This is as true of the mind as of the body.

(*c*) *Loss of structures and functions:* From time to time features that were at first useful are discarded. Thus the milk teeth are displaced by more permanent ones, but these in turn also disappear. "Baby talk" lapses long before "foreign languages" are acquired.

(*d*) *Acquisition of new features:* Among physical traits the beard and the wisdom teeth will serve as examples. Interest in drawing, in science, and in vocational activities show the same thing.

(*e*) *Integration or organization:* The various powers, interests, and activities become more and more bound together into an intimate unity, which comes to be the individual's "self" or "personality."

(*f*) *Disintegration and decay:* The decline in all these respects which comes with "old age" is also a part of development.

Laws of development. 1. *The effectiveness of training varies with the level already reached by maturation.* Ability to make the movements and coördinations called for in walking, in climbing stairs, in writing, and the like, *mature* in the growing child only by a certain age. The age varies somewhat with the child, but the growth depends upon changes in the organism, upon incidental activity and a complex set of factors that do not require *special exercise* in the acts themselves. If children are *taught* to walk, to climb or to write before this level of maturation is reached, some progress may be made. But at a later time, when maturation is more advanced, a much shorter period of training will be just as effective. Training undertaken before the proper level of maturation is reached may therefore result in wasted effort and may even be wholly useless.

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[1] For a detailed account of the course of human development see H. L. Hollingworth, *Mental Growth and Decline* (D. Appleton & Co., 1927).

2. *Development moves gradually, rather than by leaps and bounds.* In Chapter VII we show several curves of learning ability as related to age. Nowhere in these curves are there sudden changes; the progress is continuous and reasonably steady. Curves showing growth in other abilities, and in such physical traits as height, weight, strength show the same smooth progress. Slight irregularities in the growth of any single individual may be expected, for all living activities show a certain variability. But the notion that development "leaps" or "spurts" at certain crucial points in the life career is not borne out by measurement. When leaping development appears to happen, it is usually the case that only the manifestation or expression is sudden; the underlying growth has been continuous. Children do, for example, *suddenly* require new shoes, and larger sizes. But the feet do not increase in size with this suddenness.

3. *Different traits develop at different rates, and reach their maximum at different times.* Physical traits afford familiar examples, but the same rule applies to mental abilities. Thus the size of the skull increases rapidly from the beginning and by the time the child is 7 years old the skull will have attained about 95% of its maximum size. If we let the condition at 18 years of age represent "maturity," we find that at the age of 10 years the average child has reached the following percentages of his mature status in various traits:

Trait	*Per Cent of 18-Year Status*
Strength of grip	37
Weight of the body	48
Sensitiveness to pain	65
Stature (standing)	78
Rate of tapping	82
Size of skull	96

A child is therefore, at any given age, "more mature" in some things than in others. Since the effectiveness of training depends in part on the level of maturity, it will be seen that an intimate acquaintance with the facts of developmental psychology will be of great use to any educator, whether teacher or administrator.

4. *Development commonly proceeds at the pace at which it starts.* This is true of separate organs and functions. It is also true of the general rate of development of the individual as a whole. And it is as true of mental as of physical traits. Individuals who are destined to be superior or inferior show these traits at the earliest ages at which they can be measured, and on the whole they continue to develop at the pace shown in their earlier life.

Not only do superior organisms show their superiority in the earliest stages of their career; they also on the whole continue to develop for a longer period of time. The result of further development is therefore constantly to magnify the differences which were there in the beginning. The following sets of curves show these facts in the case of height and intelligence. In the first set [2] are shown the changes in height for the same boys and girls, measured at different points in their development. In the second set of curves [3] are shown similar results from the repeated mental measurement of individuals ranging in intelligence from idiots to border-line degree of normality. In the third set is given the generalized

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[2] From Baldwin and Stecher, "The Mental Growth Curve of Normal and Superior Children," University of Iowa Studies in Child Welfare, II, No. 1.

[3] From F. Kuhlmann, "The Results of Repeated Mental Examinations of 639 Feebleminded over a Period of Ten Years," *Journal of Applied Psychology*, September, 1921.

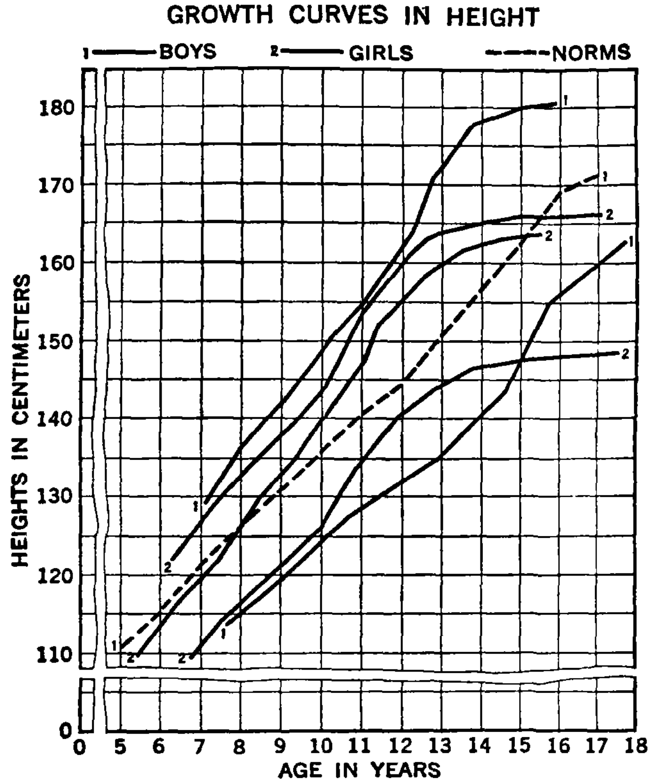

FIG. 5.—CURVES OF GROWTH.

The age norms or averages are shown by the broken line Children who are shorter than average, at 6 and 7 years, continue to be shorter and those who are taller continue to be taller, throughout the course of growth. (From Baldwin and Stecher, University of Iowa Studies in Child Welfare, II, No. 1, 1922. Reproduced by permission.)

picture of the results of many such measurements in the case of children of different degrees of mental ability.

5. *Correlation rather than compensation is the developmental rule.* One of the most striking outcomes of the measurement of human abilities confirms the ancient rule—"To

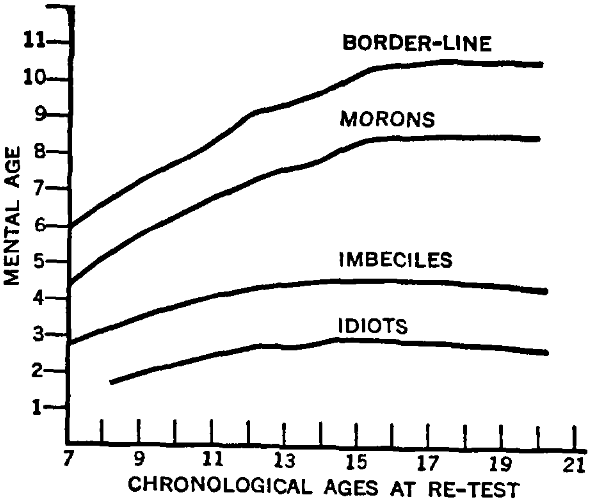

FIG. 6.—THE GROWTH IN MENTAL AGE OF GROUPS OF INDIVIDUALS OF DIFFERENT INTELLIGENCE LEVELS, AS SHOWN BY RE-TESTS AT VARYING INTERVALS OVER A PERIOD OF TEN YEARS. (Adapted from Kuhlmann.)

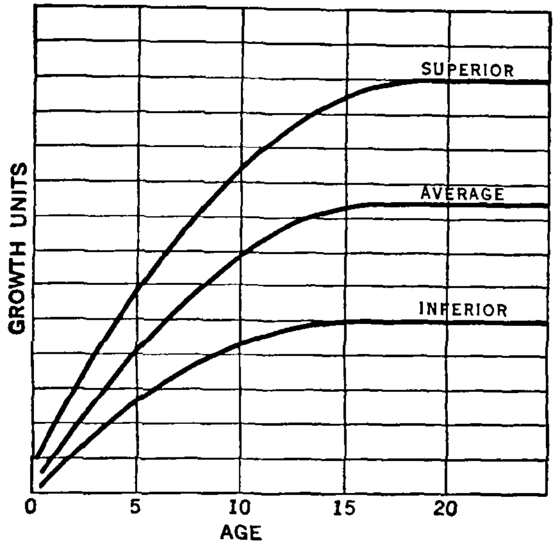

FIG 7.—CURVES OF MENTAL GROWTH.

Showing the observed differences in (*a*) initial status; (*b*) developmental pace; (*c*) period of growth; and (*d*) final limits of attainment in the case of individuals who are superior, average, and inferior in intelligence.

him that hath shall be given." On the whole, organisms that are well endowed in one respect are also well endowed in others. Taking them as a group, children who are brighter are also taller and heavier, age for age, than those who are less bright. Even "good looks," as judged by people who do not know the individuals, go along with good mental ability, as measured by tests and by school achievement.

It is true that the brightest child in the class is likely to be among the smaller ones; but this is because he is also likely to be *younger* than the others. It is also true that there are many exceptions to the rule, and that the correlation is far from perfect. This is because the degree of each trait depends upon so many different factors. To choose a rough example, the stature of one parent and the intelligence of the other may dominate in the make-up of the child, and this complicates things. Nevertheless, when numbers of cases are taken, the general law is shown clearly.

The detailed evidence for this general rule, and the qualifications that must be made with respect to it, cannot be undertaken here. Again the interested reader must be referred to the wealth of material to be found in the science of differential psychology, the study of which should be part of the further training of students of educational psychology.

Psychographs of three pupils. Having seen briefly how mental traits may be measured and compared, and having considered some of the important laws of mental development, we are ready for a study of some individual pupils. Each of these pupils was measured in a variety of abilities, which are indicated by the names along the base-line of the charts or psychographs here given. Without describing each of the traits or "tests," we may indicate the way in which they are arranged on the graph.

On the left are placed rather simple physical and motor activities, such as strength of grip in the hand, rate of tapping with the hand, and target hitting (coördination). Then come various activities in the handling of forms (Seguin form board), the discrimination of figures (cancellation), which we may call sensori-motor activities; then come simple tests of learning and of the use of facts already learned (substitution, word building, completion tests); finally come acts calling for quite new learning, and for the use of materials that are very symbolic—words, logical relations, printed and complicated directions.

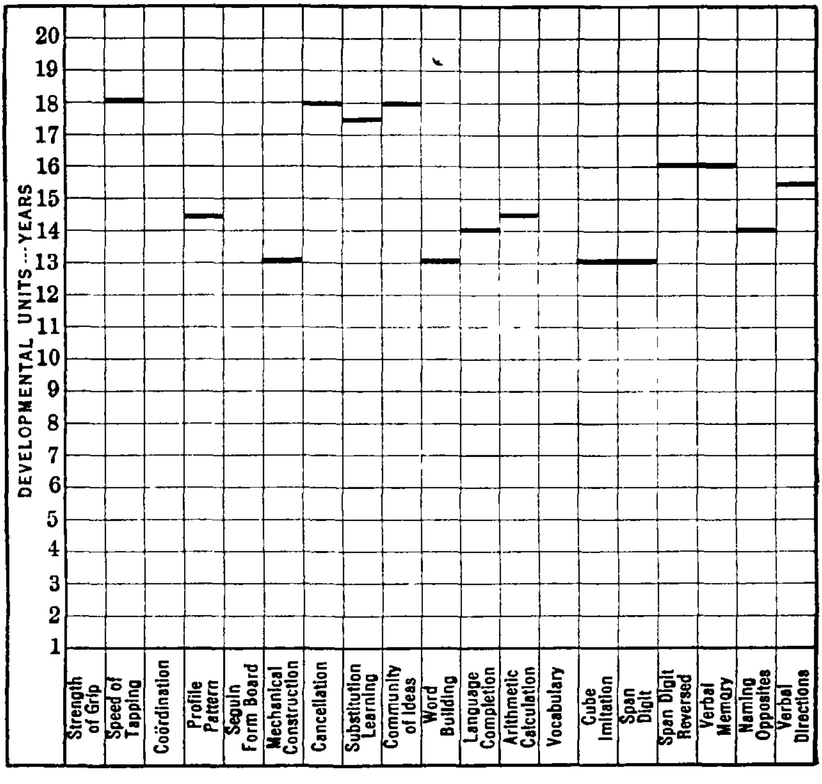

FIG. 8.—PSYCHOGRAPH OF BOY A (15 YEARS).

On the vertical axis at the left are shown the units of measurement, and we shall use units of developmental age. Across each column, above the trait named, we draw a short heavy line that shows the ability of the pupil in that trait—his mental age or developmental age in that trait. Study of these three graphs is very instructive for educational psychology.

Look first at the graph for boy A. He is a "normal" or average boy. His actual age is 15 years. But he is not *exactly* 15 years in any of the things measured. He varies about the 15-year level, being below in some things and above in others, of those measured. Some of these variations are due to inaccuracies in the measurements; some of them are due to the fact that this is the way *average* boys are built. They are better in some things than in others, but on the whole they vary about a certain level, which is the average of all their abilities. The average ability age of this boy, the average of all his separate measures, is just about 15 years, and since this is also his actual age, we call him a normal boy.

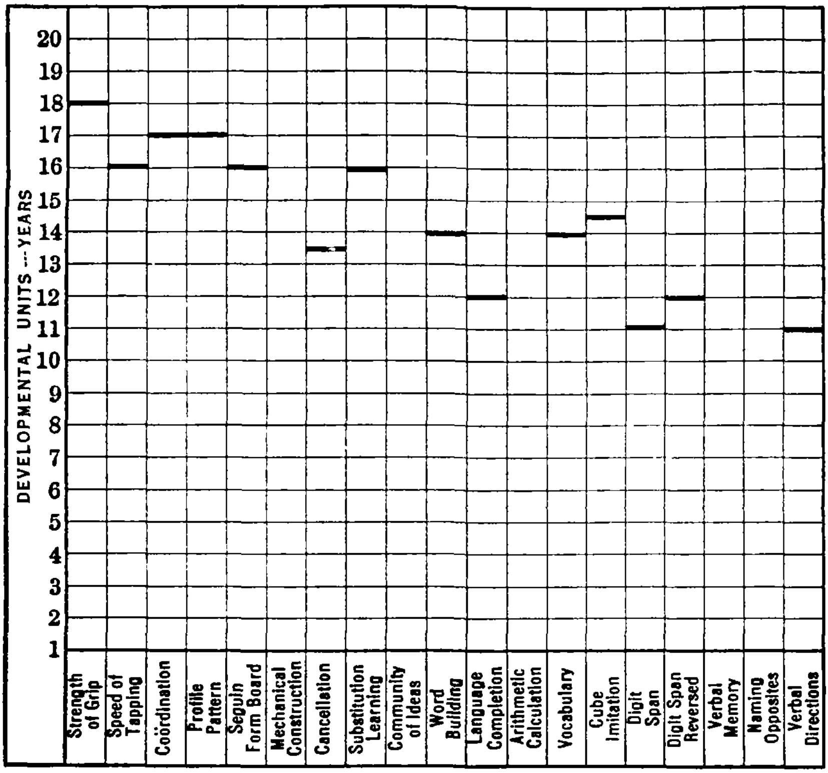

FIG. 9—PSYCHOGRAPH OF BOY B (18 YEARS)

The lines showing his various abilities march across the chart in a horizontal fashion.

Compared with this, boy B is a striking contrast. He is actually 18 years old. In the abilities shown at the left of the graph he is close to normal, although even here his measures fall below, rather than above the 18-year level. And as we go across the graph, to the more and more complex and "symbolic" activities, his abilities fall lower and lower. In general the measures march *downward* as they go across the graph. But the average of all these measures is also just about 15 years, as was the case with the first boy. The two boys have the same developmental or ability age, but one of them at-

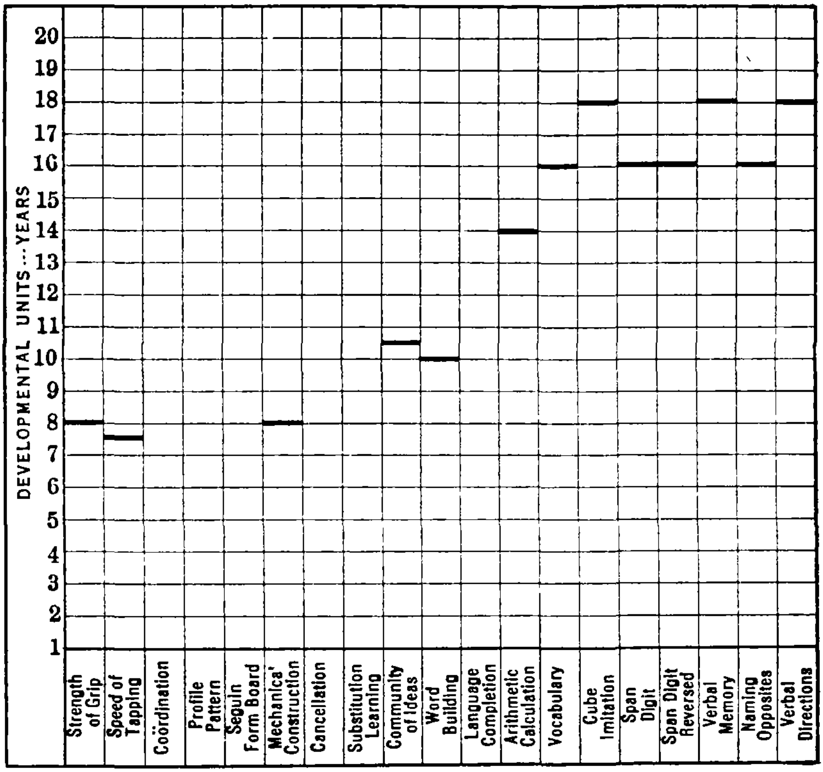

FIG. 10.—PSYCHOGRAPH OF BOY C (8 YEARS).

tained this when he was 15, the other only when he was 18 years of age.

Boy C also has an average ability of about 15 years. But what a different picture he presents; what a different *mind* he has! Actually he is only 8 years old. In the traits shown on the left half of the chart he is close to this age in ability. As we go across the graph to the more complex and symbolic activities, this boy climbs higher and higher on the scale; in some of these he has already reached the ability expected of average 18-year-olds.

All of these boys have the same average ability, the same ability age or performance age. But one is 8, one 15, and one 18 years old. If we divide the performance age of each by his actual age we get quotients which are 1.72, 1.00 and .83. On the basis of 100, these become 172, 100 and 83, and they may be called performance or ability quotients. When such quotients are based only on performances of the symbolic or mental sort they are called "intelligence quotients." Such quotients may be secured from an array of single tests, such as those used here, or they may be secured through various *scales*, made up of a miscellaneous list of performances which give at the end only a *net result*.

If the reader will now turn to the graph on page 177 which shows the distribution of human traits, he will be able to see the frequency with which people of these various degrees of ability occur in the total population. The units on the base-line of that graph may now be taken to represent "ability quotients."

The boy with the quotient of 100 would stand just in the middle of the total group, and about half of the population would be very much like him in general ability. The boy with the quotient of 83 would be so low in the scale that only about 10 per cent of the population would have less ability than he. As for the boy with the quotient of 172, his ability is so exceptional that no good provision has been made for him on the graph. He would be among those in the extreme upper end of the graph, which really extends upward to about 200, which is about the highest quotient that has ever been found. Such a boy would be "one in a thousand," or even more rare than this.

The pattern of mental ability. These three boys represent typical ways in which the pupils in any class may vary, in that which we call *brightness*. But it is important to know that brightness and dullness are not simply the presence or absence of some one thing. The dull individual is one who has difficulty in working with symbols, who has difficulties in learning, does not respond readily to reduced cues. The bright individuals are those who are especially apt in doing these things.

But the pupil who is dull is not likely to be normal in every other respect. Instead, brightness or dullness reflects a certain quality of the organism, and this quality is shown in most of the traits of the individual. But it appears to different degrees in different traits. The graphs of the three boys show the pattern of this variation.

In physical, structural and motor respects both the dull and the bright are more like the normal than they are in mental ability. But even here the bright are somewhat superior, the dull somewhat below the norm. In sensory and simple perceptual processes the differences are greater still. And the more functional the activity is, the more complex, and the more it requires symbolism and cue reduction or learning, the greater the differences become.

One result of this is that pupils are more nearly alike in some things than in others. They are more nearly alike in height than in weight or strength; they are less alike in working directly with objects, in using their hands in simple acts of skill; still less alike in sensori-motor activities such as typing; and so on, until in activities requiring a high degree of skill in the use and understanding of symbols (such as algebra, reading for comprehension) the differences between them become so great that even casual observation reveals them. All of these things are true even when the pupils are of the same sex, age, race, etc.

These facts result in many practical difficulties for teaching and administration. Pupils who are enough alike at a given age to get along well together in manual training, in drawing, penmanship and athletics, will begin to differ widely when they undertake activities involving the simple and rote use of symbols, such as words, numbers, arithmetical signs. They will differ so widely that many of them cannot even undertake the assignments that others handle with ease. When composition, geography, grammar and similar subjects are undertaken, with the necessity, not only of using symbols in a rote fashion, but also of understanding them, a new adjustment or grouping of pupils must be made. Such adjustments and changes of placement or assignment will become more and more noticeable the farther the pupil goes along the school route. The problem of teaching becomes increasingly acute.

On the one hand these facts have led to many kinds of "special education." On the other hand they have led to the introduction of educational and vocational guidance as an important part of the work of the school, along with teaching and administration.

Mental patterns and general level of ability. Some of the general facts of mental pattern are shown by comparison of groups of normal, dull and bright individuals in traits of a more specific kind. The results confirm those shown here in the analysis of the individual pattern. Thus Norsworthy[4] determined the percentage of individuals in a mentally deficient group who reached the median ability of a control or normal group. If the groups were equal, just 50 per cent would be the figure. The actual figure was always less than this (showing the general organic inferiority), but the figures varied considerably with the trait measured (showing a definite pattern in the inferiority). The results were as follows:

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[4] N. Norsworthy, "Psychology of Mentally Deficient Children," *Archives of Psychology*, No 1. See also Hollingworth, *op. cit.*, Ch. vi.

Trait Measured	*Per Cent of Mental Defectives Who Attained the Normal Median in That Trait*
Per cent necessary to be equal to normal	50
Pulse rate	49
Height	45
Weight	44
Discrimination of weights	18
Genus-species association test	9
Canceling A's from a page of print	9
Part-whole association test	9
Memory for unrelated words	6
Memory for related words	5
Naming opposites of words	0

The inferiority of the defectives is general, but it is not equal in different directions. In some respects they are more defective than in others. They are most nearly normal in the structural and sensory measurements.

In a somewhat similar way we may compare the measurements of a group of intellectually bright children with those of a group with average intelligence.[5] The difference here we may express as a percentage of superiority. The difference in

Trait Measured	*Per Cent by Which the Gifted Excel the Average*
Per cent necessary if both groups are equal	0.0
Sensory musical capacity	0.0
Circumference of head	1.7
Standing height	4.0
Strength of grip	6.8
Foot-pounds jump	6.8
Weight	15.6
Reading, understanding paragraphs	43.4
Intelligence quotient	50.0
Arithmetic computation	76.0
Spelling at dictation	176.0
Arithmetic reasoning	184.0
Vocabulary, word meaning	213.0

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[5] L. S. Hollingworth, *Gifted Children* (Macmillan Co., 1926).

actual units is divided by the average of the normal group in arriving at this figure.

The superiorities of the bright range here from just no superiority (musical tests) to a score three times as high (vocabulary, plus 213 per cent) as that of the normal. But the net intelligence quotient shows a superiority of 50 per cent. There is then a general tendency to superiority; but the superiority is patterned; it is greater in some respects than in others.

It is also instructive to compare in this way two groups, both of which are distinctly superior to the average in general ability. In this case[6] there are 20 children, of the same age, sex and race, and working in the same school, in each of two groups. One group contains children with intelligence quotients averaging 146, ranging from 139 to 156. The other group contains children with quotients averaging 165, ranging from 152 to 183. Both groups are very superior, but one is superior to the other.

During observation and measurement over a period of three years these two groups showed progress in various types of school work as shown by standard measures of school achievement. Both groups advanced more rapidly than a normal group. But the *very* high group advanced more rapidly than the high group, and the difference showed itself more markedly in some kinds of work than in other kinds. What were the kinds of activity that thus served to separate or distinguish the *very* bright from the bright?

In the following table the results are shown, the measure being the number of months of study saved by the *very* bright in reaching the highest achievement of the bright group. The greater the saving, the greater the difference in ability between the two groups.

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[6] L. S. Hollingworth and M. V. Cobb, "Children Clustering at 165 I.Q. and Children Clustering at 146 I.Q. Compared for Three Years in Achievement," National Society for the Study of Education, *Twenty-seventh Yearbook,* 1928, Part II.

TIME SAVED BY THE 165 I.Q. GROUP AS COMPARED WITH THE 146 I.Q. GROUP IN ATTAINING A GIVEN LEVEL OF ACHIEVEMENT

Process Tested *	*Months Saved by Higher Group*
Word Meaning (Stanford Achievement, No. 3)..	16.0
Paragraph Meaning (Stan. Ach. 1)..............	15.0
Sentence Meaning (Stan. Ach. 2)................	14.5
Nature Study and Science (Stan. Ach. 6).........	14.5
Understanding Paragraphs (Thorndike-McCall)...	13.5
Addition of Fractions (Monroe Diagnostic Test, 9).	13.5
Long Division (Mon. Diag. 6)....................	13.0
Multiplication, Whole Numbers (Mon. Diag. 8)..	13.0
Spelling from Dictation (Stan. Ach. 9)..........	12.5
Language Usage (Stan. Ach. 8)................	11.0
History and Literature (Stan. Ach. 7)............	9.0
Long Division (Mon. Diag. 11)................	9.0
Subtraction, Whole Numbers (Mon. Diag. 2).....	9.0
Division of Fractions (Mon. Diag. 16)...........	9.0
Subtraction of Fractions (Mon. Diag. 13).........	9.0
Speed in Silent Reading (Ayres-Burgess).........	8.5
Arithmetic Computation (Stan. Ach. 4).........	7.5
Multiplication, Whole Numbers (Mon. Diag. 10)..	7.5
Arithmetic Reasoning (Stan. Ach. 5)............	7.0
Multiplication, Whole Numbers (Mon. Diag. 3)...	7.0
Addition of Fractions (Mon. Diag. 12)..........	6.5
Subtraction, Whole Numbers (Mon. Diag. 9).....	6.5
Division of Decimals (Mon. Diag. 19)...........	6.0
Short Division (Mon. Diag. 4)..................	6.0
Multiplication of Decimals (Mon. Diag. 18)......	5.0
Multiplication of Fractions (Mon. Diag. 14).....	5.0
Division of Decimals (Mon. Diag. 17)...........	4.0
Division of Decimals (Mon. Diag. 20)...........	4.0
Multiplication of Decimals (Mon. Diag. 20).....	3.5
Addition of Whole Numbers (Mon. Diag. 7)......	3.0
Addition of Whole Numbers (Mon. Diag. 1)......	0.5
Addition of Whole Numbers (Mon. Diag. 5)......	0.0

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* The notations in parenthesis identify the precise test used, usually one of the Stanford Achievement Test series or the Monroe Diagnostic Tests series. Fuller explanations of the nature of such tests will be found in a later chapter (Ch xiv) but it is not necessary to know the nature of the test in detail to understand the meaning of this table of results.

Not only is there a pattern of ability that distinguishes dull from normal, and normal from bright; pattern differences are also seen between the *very* bright and the bright. In some of these school activities the *very* bright gain less than half a year over the bright; these are the straight computation processes involving mainly whole numbers and decimals. In some activities, on the other hand, the *very* bright gain a year or more as compared with the bright; these are mainly processes involving the use and understanding of verbal symbols. Between these two extremes fall the computations involving fractions, arithmetic reasoning, and computations in which rote associations are combined with various other sorts of complex habits.

Some activities, that is, serve better to differentiate the very bright. For activities such as these an added increment of intelligence, over and above the high intelligence of the bright group, counts demonstrably. For those processes that do not so effectually differentiate the two groups we may conclude that beyond a certain point, represented by the intelligence of the bright group, added increments of brightness need not make significant differences in performance.

For every general level of ability, therefore, there may be said to be a characteristic pattern of ability. And for every individual there is also his or her particular pattern or make-up, approximating but deviating individually from the typical pattern of his or her general level. This only serves to emphasize the importance of the individual study of the learner.

Vocational and educational guidance. Vocational guidance in the strict sense can make only modest claims at present. The choice of a career depends on many factors that cannot yet be measured or predicted by the counselor. Interests; moral traits; social traits; capacity for enthusiasm, persistence, ambition, leadership, represent such traits in the pupil. Changes in the work of the world, in the supply of various kinds of trained workers, in the circumstances and resources of the pupil's family, all these also play a part. But much can be done in the schools by way of:

(*a*) Providing information concerning the varied kinds of work the world affords; the conditions and fruits of success in them; the requirements, by way of experience and training; and the important personal qualifications of those entering each field.

(*b*) Providing information concerning the make-up, the endowment, the pattern of aptitude and ability of the pupils themselves, and adapting their education as well as may be to these characteristics.

A large part of the problem of vocational guidance thus comes to be educational guidance. What course of study shall each pupil be encouraged to undertake? What curriculum is most appropriate for each? How can the learning career be planned so as to relieve the greatest amount of distress in the learner and in the social group of which he is a member?

The three boys whose ability patterns we have been considering all presented problems of this kind. In order to offer any advice at all, it was of course necessary to secure much more information than is represented in these graphs, information that cannot yet be measured, and some of which may not be very reliable. This had to do with such things as the interests of the boys; their work habits; their emotional and character traits; their present economic resources; their own plans and ambitions; their physical health and vigor. A brief consideration of the problems they presented will serve to illustrate the present possibilities of educational guidance.

Boy A

Boy *A* was robust, modest and coöperative. His parents were worried because he was having difficulty with the college preparatory course they insisted on his pursuing. They wished him to enter a prominent eastern college, then follow professional training for a career occupied chiefly with impersonal and abstract matters, such as those in which some of his uncles had succeeded.

The boy had struggled to meet these ideals of achievement, but with constant failure. He was especially interested in automobile mechanics and in work with tools and concrete materials and projects. He had learned to do things of this kind reasonably well and had found satisfaction in them.

The examination showed *A* to be an average boy, with an ability quotient of about 100, and with slightly less ability in working with symbols than in manual and sensori-motor activities. The average ability quotients of those who succeed in college training leading to professional careers is about 130. In such a career this boy would meet with constant discouragement and difficulty. Since both his interests and his best abilities lie in a different direction it seemed wise to put the facts of the analysis at his disposal and in the hands of his parents.

The boy then changed to a prevocational high school and also continued practice in playing a band instrument in which he had some interest. In this new field he made good progress, was well liked, and was soon looking forward with enthusiasm to a career in building and machine construction.

Boy B

Boy *B* had a history of delinquency, insubordination and mischief. His main interest was in driving a truck. He had run away from school and succeeded in finding a job driving a delivery truck, which he did with reasonable skill, and to the date of examination, without serious accident.

He had been sent to private "preparatory" schools, given special tutors, but had shown neither interest nor success in academic work. His family, who occupied a conspicuous social position, were inclined to attribute his behavior to the influence of bad companions and hoped that if the right tutor could be found the boy could still be "prepared for college."

The examination showed this boy to rate as low as 11 or 12 years in abilities most closely associated with the term "intelligence." But in motor, manual and physical respects he was more nearly up to the level of his actual age, 18 years.

A 12-year "mentality" combined with an 18-year "physique" is the picture presented by many "delinquents." Such individuals are constantly led into physical escapades and acts the "nature and quality" of which they are unable to appreciate.

What such a pupil most needs is training in habits of work, sobriety, self-respect and social consideration, coupled with very specific trade skill, in some useful, remunerative and "unintellectual" field which appeals to his interests.

Boy C

Boy *C* was "discovered" by a discerning kindergarten teacher who reported him to be unusually bright. He was early examined by a general intelligence scale, and found to have a phenomenal "intelligence quotient." He was allowed to move rapidly through the lower grades, and an "enriched curriculum" was provided by activities which he developed on his own initiative and that of his parents.

From time to time he was measured in a variety of abilities, and his teachers informed of the outcome. He was allowed to depart from the "lock step" of the grades. He was soon three years ahead in age-grade status and studied privately geometry, Latin, Greek, French, German, four other languages, and astronomy. He was taller and heavier than the standards for his age; he did not care for childish plays, and in tests of manual dexterity he was no better than average.

Before his twelfth year he had finished high school, and passed the comprehensive examinations for college admission. At 12 he made next to the best record among 483 candidates in a "college aptitude test," the average age of his competitors being 18 years At 13 he scored 194 points in the Army Alpha Intelligence scale, the average for his age being only 47 points and the average for freshmen in the best colleges being but 150.

At 15 he finished college with distinction, having also taken part in class exploits and battles, and extra-curricular activities, including the class play. With equal promptness he earned his Ph D. in abstruse subjects and entered upon an active life of scholarship and service in a special field of teaching and research

The developmental basis of prediction. Educational guidance and prediction are possible because abilities grow according to the laws of development we have briefly outlined in this chapter; because the course of development tends to be uniform; because the individual tends to maintain the pace at which he starts; because the ages at which various traits ordinarily come to maturity can be known; because individual learners differ from one another according to rather definite patterns; because human beings are more alike in their physical needs and fundamental cravings than they are in ability to satisfy those needs; because human aptitudes are positively correlated, rather than conforming to any law of compensation.

For this reason it is no longer necessary, as was the case

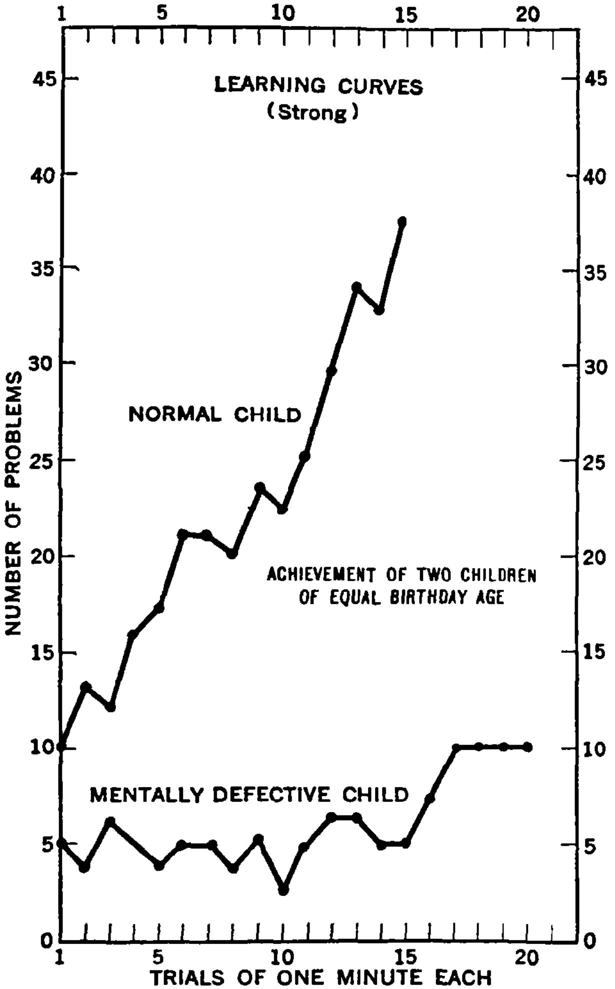

Fig. 11.—Curves Showing the Course of Learning in a Defective Child, and in a Normal Child, of Equal Birthday Age. (From Strong.)

with Boys *A* and *B*, to wait until maladjustment shows itself before taking thought for the future. Effective educational guidance is best illustrated in the case of Boy *C*, in which case measurement and prediction as early as the years of kindergarten attendance made possible the effective adjustment of method and curriculum to the characteristics of the learner.

The developmental basis of prediction, and the relation of learning ability to the individual's "pace" of development are clearly shown in two experiments, the results of which are here shown in the form of graphs. In the first case [7] there

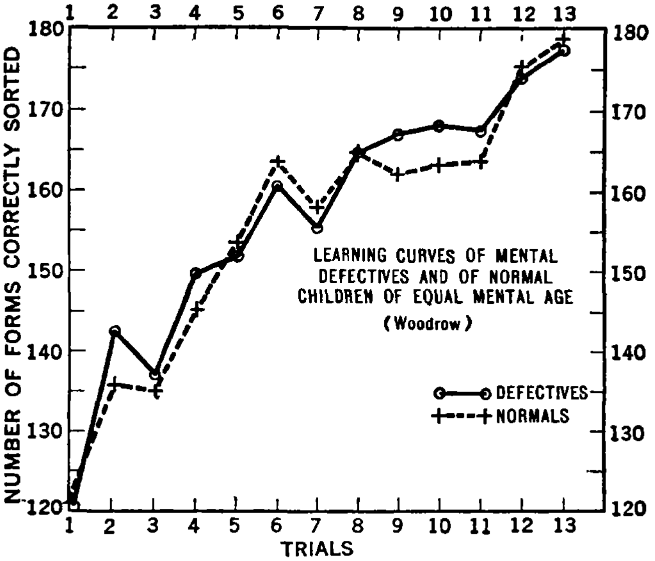

FIG. 12.—CURVES SHOWING THE COURSE OF LEARNING IN DEFECTIVES AND IN NORMAL CHILDREN, OF EQUAL MENTAL AGE. (From Woodrow.)

are shown the learning curves of two children, when a definite act was repeated many times. The two children were of the same actual or "birthday" age. One of them however was so low in developmental age, ability age, at the time of the experiment, as to be called mentally defective. This condition is only a very low level of general ability, and is due to a very slow pace of development. The other child was normal for its age, showing in various tests of ability the score to be expected of average children of that age.

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[7] E. K. Strong, "The Learning Curve as a Diagnostic Measure of Intelligence," *Psychological Bulletin*, Vol. 14, 1917.

The two curves of learning differ strikingly. In the case of the defective child the improvement is very halting and slow, and amounts to but little at the end of the training. In the case of the normal child the curve climbs steadily upward, and there is no indication that the maximum skill has been reached at the end of the training.

The comparison illustrates the general rule, that ability to learn is closely related to the general ability of the learner, rather than to the number of years he has lived.

In the second graph[8] two learning curves are also shown, from experiments with two groups of children. In this case the learners differ considerably in actual age. But in ability age, or developmental age, as shown by tests of proficiency, the two groups are equal.

The two curves of learning are quite alike, both in rate of improvement and in the level reached after equal amounts of training. Again the fact is illustrated that it is "ability age," or what is more commonly called "mental age," on which the rate of learning depends. It is because of such facts as these that the work of the school psychologist is being put increasingly to good use by the teacher and by the administrator.

The effect of education on individual differences. When pupils begin to study or practice any particular thing, they will differ in their initial ability. What is the effect of training on these differences? Does education make people more alike or more different? If different amounts of training were given to different learners, the effect would depend on who was given the most training. Denying training to the able and supplying it to the inferior would tend to make all more alike. Denying it to the inferior and giving it to those already more able would increase the differences. The psychological problem is—what happens when people of different initial ability are given *equal* amounts of training, or equal opportunity to profit from practice.

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[8] H. H. Woodrow, "Practice and Transference in Normal and Feebleminded Children," *Journal of Educational Psychology,* February, 1916, and March, 1917.

Many experiments have been made on the effect of training on individual differences.[9] The results vary with the process measured, the people studied, and other conditions. But a survey of all the investigations yields a very clear result. When the individual differences, in the beginning, are relatively small, equal amounts of practice either leave them unchanged or sometimes decreased. When the initial differences are large, the effect of equal training is to make them still larger.

As we have seen, the traits in which individual differences, due to nature and to incidental activity, are small, are the simpler, more structural, sensori-motor activities, not closely related to what we think of as "mental ability." The more "mental" the trait, the greater are the initial differences, due to heredity and maturation. In human life it is likely to be just these latter differences that are most important; and these are the differences which are not "equalized" by equal training; instead they are just the traits in which equal opportunity makes people more different than ever from one another.

We may think of the individual differences among the members of a group as a trait of the group—namely, its *diversity.* The effect of training is to enhance what is already there. If *little diversity* is present, training emphasizes this similarity; if *great diversity* is present, equal training makes this diversity greater than ever.

Uninformed educators who idealistically contend that "There are no dull pupils in our schools"; "Different opportunity alone is what makes differences in men"; "It is up to the teacher to see that all her pupils are brought up to normal before they leave her class"; ought speedily to become acquainted with the facts of individual differences, the laws of development, the relation of learning ability to general intelligence, and the effects of training on human diversities.

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[9] A useful summary of 40 such investigations will be found in a paper by J. Peterson and M. C. Barlow, "The Effects of Practice on Individual Differences," National Society for the Study of Education, *Twenty-seventh Yearbook,* 1928, Part II.

PROBLEMS

1. Mention several psychological "traits" that are clearly aspects of the whole person.
2. Mention traits that might even be said always to involve two or more persons.
3. What criticisms might be offered of the concept of "mental age" or "developmental age"?
4. Illustrate each of the types of developmental change, using mental characteristics as your material.
5. Find further concrete examples or illustrations of each of the five basic laws of development.
6. Find tables of results showing the correlation of traits among individuals by means of numerical coefficients of correlation, and discover from books on statistics or mental and educational measurement just what these figures mean.
7. If materials are available, a number of tests with standard norms may be given by the group method, after which each student may draw his own profile so far as revealed by the tests used. Correlations may also be made, if the instructor thinks this would be instructive.
8. A study of the relative variability of the members of the class in several traits or measures, such as stature, weight, intelligence score, points of college credit, will afford an instructive exercise. Use Pearson coefficients of variation or some similar percentile figure.
9. Read some book on vocational guidance and report to the class what methods are now in use in schools
10. What practical differences does it make whether education makes people more alike or more different?

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PART II

TECHNIQUES OF INSTRUCTION

CHAPTER VII

THE PSYCHOLOGY OF TEACHING

The guidance of learning. Learning may run its course without conscious guidance or plan; daily experience will result in cue reduction, and those capable of learning will come to face the future in the light of what the past has done. We may distinguish between learning and education; education will be a term for the planned and organized guidance of learning. The engineer of such guidance we may call simply the teacher. Teaching is a subtle art, although its underlying basis is simple enough—it follows directly from the psychology of learning. Let us consider what the work of the teacher is, and how it may most effectively be conducted.

The teacher is first of all interested in certain acts. Some behavior is preferred to other behavior; acts of a certain sort have a premium; they are "desired" by the pupil, by society, or approved by authority or tradition. It is the work of the teacher first to know what these approved responses are, and, by teaching, to help produce acts of this kind more expeditiously, certainly, and frequently than they would naturally occur, if the pupil were left "uneducated."

Furthermore, it will not be expected that such acts shall occur "out of the blue sky," uncaused, or without reference to what goes before them. Each desired act will be in response to some general situation, and in the case of learned acts, it will be aroused by some feature, detail or cue, in that situation, acting now as it has acted in other contexts or occasions.

Typical items of instruction. To be concrete and specific, let us here list a number of samples of such desired acts, showing in the case of each the particular cue or stimulus which is expected to be capable of producing it. Thus it is desirable that—

Drivers of motor cars be capable of applying the brake promptly	In response to a signal such as that of the traffic officer, or a red light
Children of a given age be able to write their names legibly	In response to a verbal request to do so
Adults be able and ready to spell words correctly	When it is necessary to write them
Citizens be capable of acting according to instructions	When these are presented in the form of a telegram
Clerks be prepared to know the product of two numbers	Without first having to count things up on their fingers
Human beings be disposed to act politely rather than with savage outbursts	When in a social situation
People respond by effective attack and adjustment, not by crying, deceit or collapse	When confronted by a difficulty, a temptation, or a danger

We may briefly express such things in terms of our diagram of the learning process in the following way. Certain terminal acts *T* are to be aroused by certain details *D* present in a given situation, with reasonable certainty and promptness.

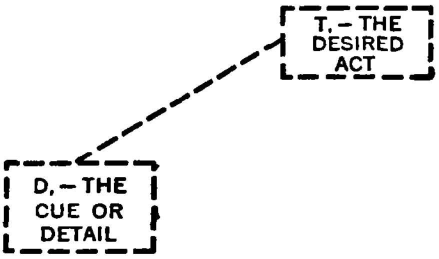

Fig. 13.—The Result of Learning.

Enriching the pupil's experience. By definition, *D* is a detail or cue which would not have led, natively or originally, to such a particular act as *T*. The teacher's next concern, therefore, is to discover just what life experiences, what situations, backgrounds or contexts, what motives or influences, *will* produce acts of this kind. These, as we have seen, will often be complex and time-consuming experiences. Thus the rat, *at first,* can be made to go from one end of the maze to the other only by putting it in the maze when it is hungry, placing food at the goal, withdrawing other distractions, and permitting the animal to engage in that frantic and "wasteful" scampering which characterizes its first successful trip. And in this background or first experience there must be imbedded some cue of the sort which is expected, in later life, to act directly and promptly in producing the desired act without wasteful fumbling.

The pupil must therefore be provided with such an adequate background, either directly, or in some *vicarious* way, as through speech, reading, picture, or observation of others. In the teaching of history, for example, this must be done by some concrete introduction to human institutions, through visits to museums, to battlefields and monuments, through films and pictures, and through social enterprises and inventions undertaken by the pupils themselves.

In geography, again, it must be done by some sort of "enriched experience," such as travel, collections, conversation with foreigners, drawing maps of the school grounds, investigating the topography, the resources, the industries, of the local neighborhood.

In the teaching of civics such background may be found in the social activities of the pupils themselves, in their mutual relations on the playground, in organizations for their own management, in the observation of local elections and civic enterprises, in planning a budget for some undertaking of their own, in the election of their own leaders and representatives on the school council, and so on.

The chief problem here is that of making sure that these vital and concrete experiences *are* such as will ultimately lead to those acts, experiences, judgments, feelings or attitudes which are the desired ones—the ones that, in later situations, are expected to be touched off by slight details of these earlier backgrounds. If the outcome of these experiences is wrong, then not only has the instruction failed, but it has imposed positive handicaps in the way of subsequent correction and reëducation.

We may now add to our diagram another section which will represent these initial, vitalized contexts which are found to lead effectively to the desired terminal acts, and in which the specified signal or cue, *D,* is imbedded as a detail. Our diagram is then as follows:

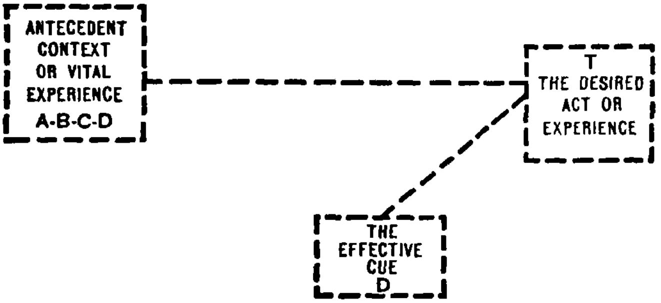
ANTECEDENT CONTEXT OR VITAL EXPERIENCE
A-B-C-D
T
THE DESIRED ACT OR EXPERIENCE
THE EFFECTIVE CUE
D

FIG. 14.—ANALYSIS OF TEACHING.

Knowing the desired terminal act; having selected the cue that is to be, in the future, promptly effective; and having discovered a vital antecedent which will, through original nature or through previous training, produce such a terminal act; having seen to it that the future cue, or a cue very like it, is imbedded in this original experience—there remains a final task. This may be briefly summed up in the word *drill.*

By this we mean simply that, by whatever methods are found to be most effective, this originally complex antecedent must now be *reduced,* so that in the end it need not all be required. *Cue reduction* must be brought about, so that in later life the mere fragment or detail, previously determined upon, will lead to terminal acts of the desired sort, even in situations which as a whole are quite different from the original.

We must add the observation that the experiences used by the teacher need not always be "raw" or "original" experiences. As we have seen, as soon as the pupil achieves the arts of reading and conversation, *vicarious* experience may often be substituted for "raw" experience. *Descriptions* of things may be as effective as the things themselves; and such vicarious experience is often safer, and nearly always more economical, of time, of expense, of energy. A "motion picture" trip through the Alps or through Wall Street has many of the merits and lacks many of the disadvantages of an actual expedition. To what extent vicarious experience may be substituted for raw experience, in a given case, should be decided by experiment.

Providing background and directing drill. The more usual work of the individual teacher is likely to be largely restricted to (*a*) providing background, vitalizing experience, and thus giving "meaning" to the cues and symbols; and (*b*) rehearsal and drill, that is, engineering the course of cue reduction. The desired terminal acts are likely to have been chosen beforehand, by society, by the educational experts, or by tradition. The cues that are to be effective will also be determined beforehand chiefly by the contemporary needs and activities of social life, the methods of industry, the current customs and arts.

These two processes often go hand in hand, but it is useful to be conscious of just what one is attempting. The first process, vitalizing experience, may easily degenerate or lapse into the second, as when teaching geography degenerates into the enforced memorizing of names, numbers, lists of products, rivers, and cities, the mere "copying" of maps, and glib verbal answers to unimportant verbal questions.

In the same way the second process, rehearsal or drill, may be painfully conducted but with futile outcome, if not preceded by an original background which gives genuine meaning to the cues that are manipulated. Thus drill in such operations as calculating "partial payments" may be futile because the operations and symbols used function for too small a background of experience and hence have little meaning. They thus become empty verbal or numerical tricks, not fundamentally rooted in the biography of the learner.

In "the activities of the classroom," in the "conduct of the recitation," in the "organization of projects," in fact in all the work of "instruction," the teacher will need to apply whatever is known about the quantitative laws of learning. The application of these principles will in fact constitute the "technique of teaching." Cue reduction calls for skillful engineering, and many important rules can be suggested which will help in the effective guidance of learning.

The rules, as we shall give them, are general rules and represent tendencies which must be related to one another, and also to the precise situation and materials. In fact, most of the cut and dried analysis we are here able to give would be more applicable in a completed world, in which objectives, methods, and motives were known completely and never changed. In the real world this is far from being the case. What acts are desirable? The answer is by no means always agreed upon. What motives are available? The facts themselves are highly variable, and our knowledge of them woefully incomplete. Even the details of effective technique are still in early experimental stages, and the very "laws of learning" are still subject to correction and revision.

Every educator, from philosopher to nursery school attendant, can be most effective only by remaining constantly alive, alert, and inquiring; alive, to the problems and their possibilities; alert, to every new contribution to knowledge, method, or theory; inquiring, as a student and investigator in an important and interesting field, whose activities are still scarcely over the experimental threshold.

Illustrations from the school subjects. It will be useful now to apply this analysis of the technique of teaching to representative "school subjects," with which all of us are familiar, either as pupils or as teachers. The technique involved in the elementary school subjects is more easily examined because of the relative definiteness of the materials and the rather general agreement as to what is expected to result from education. But the principles are the same in teaching of any sort—whether in training in the manual arts, instruction in professional subjects, in education for initiative and independence, in the traits of character, attitude and morality, or in the mastering of special trade skills.

We shall choose spelling and geography, partly because of their traditional character and familiarity, partly because they represent rather well two extreme pictures of instruction. In the teaching of spelling, on the one hand, the element of "drill" or "cue reduction" considered by itself, is predominant. This is true because English spelling, for example, is more or less arbitrary, often unrelated to the sounds of oral speech, and with little relation to the meaning of the object represented by the words. "Vital experience," "antecedent background," therefore plays a less conspicuous rôle in teaching of spelling than in the case of geography. It is not by any means wholly absent. Studies have shown that children learn to spell more easily and accurately words whose *meanings* they know. That is to say, context, background of experience, has something to do even in this subject which is to so great an extent a matter of drill.

In geography, on the other hand, as adequately taught, elements of drill and arbitrary sequence of one verbal element upon another are less important. The first task is that of providing the pupil with an adequate background of experience, which will give *meaning* to technical terms, to maps and outlines, to questions, problems and instruments. The element of drill or rehearsal is by no means absent, and in the hands of poor teachers or in school situations that are in various ways unfavorable, the teaching of geography may even degenerate into the tying together of verbal questions and answers. But this is not teaching geography; it is merely drill in a selected set of speech habits.

Let us now turn to a few actual samples of what goes on in teaching spelling and geography, in order to analyze these processes in terms of the diagram we have just constructed, based on our qualitative account of the nature of learning. We shall begin with spelling, as the simpler of the two cases.

Graphic spelling. We need to distinguish between spelling as written and spelling as spoken. Sometimes when we cannot spell the word orally we seize a pencil and write the word out, and find that we can do so readily enough. We may be able to make the letters look right, even though unable to make them sound correct. Graphic and vocal spelling are therefore somewhat independent processes, although one may sometimes come to the aid of the other.

In the days of the old "spelling bees" it was oral spelling that was chiefly emphasized. This was rather a curious emphasis, since as a matter of fact we are almost never called upon to spell a word orally, nor even often called upon to decide whether some one else correctly spells aloud a given word. Our actual spelling is nearly always written, typed or printed spelling; so far as early school or practical life is concerned, we need to spell only in the case of written composition. We need of course also to be able to recognize a word as correctly or incorrectly spelled when we *read* it, but this also is a *visual* rather than an auditory matter. We may perhaps suppose that these early emphases on oral spelling were made partly because of their greater *convenience* for the teacher, and partly because, in the early days of illiteracy, people with schooling were so often asked by others "how to spell" some word or other.

In graphic spelling the teaching proceeds as follows: A preliminary requirement is that the pupil be able to copy, in detail, such a pattern as a seen word with its constituent letters in the proper order. A word, such as APPLE, is then presented visually. The object that the word means, or a picture of it, is shown (raw or symbolic experience); the word is also spoken. Whereupon the pupil *copies* the word, perhaps also saying it softly or aloud to himself. We may represent this part of the process in the following way:

Seeing the apple Seeing the word Hearing the word The instruction to "copy it"	lead jointly to	Writing the word Saying the word

Thereafter, with sufficient and proper practice, the mere sound of the word is enough to enable the pupil to write it; or the sight of the picture; or his own "thought" of the word. The mere sight of the word may also become able to lead him to speak it, for this was also part of his original response. That is, at one and the same time, the pupil may learn both to "read" and to "spell," reading in this case meaning the mere pronunciation of the word. Perhaps he also got certain *feelings* in the original experience; and the sight of the word, or the sound of it, may now lead effectively again to feelings of this kind. In this case he has become able to read "for the meaning" and with a certain "understanding." The word acts as a substitute or symbol for the original situation of which it was once a part.

Some of this skill may now be represented in the following way, using the diagram we have already applied.

.... Hearing the word	leads to	writing the word

A student of spelling who has gone thus far with his learning is able to write a word "at dictation." He might actually be able to do this without knowing the names of any of the letters, or without being able to spell the word orally.

Oral spelling. A preliminary requirement is knowing the names of the letters, the names of the words, and the names of objects for which they stand. In the beginning then, hearing the word, seeing the word, thinking the word, would enable the pupil to read off the letters in order—that is to spell with the word before him.

Later the seen word may be dispensed with; the "examination is abbreviated"; a reduced cue is effective—the mere sound of the word will then enable the pupil to recite the letters in proper order. He now spells the word at dictation, giving the letters their sound names. Still later, all details of the word may be dispensed with, even its sound. The mere thought of or sight of the object enables the pupil to recite the letters in their proper pattern.

When his instruction has become "perfected," as in the case of the pupil who spells correctly in a composition or in dictating to a typist, subtle thoughts of a situation as a whole lead effectively to the correct spelling of the appropriate words, although such words have not been in mind at the moment either in visual or in auditory form. Speech and conversation thus come to proceed in "automatic" ways, and the cues that have been effective have become so finely reduced that even trained introspection has difficulty in telling what they were. We then say we write, speak or spell "without knowing how we do it." The effective cues lead so directly to the appropriate consequents or acts that the cues themselves, and cues from the context that give relevance to the words we use, escape our observation.

When a pupil spells "poorly," this means either that he has never learned to spell; or that his cues have not been so finely reduced that those now available operate effectively (he may first have to "go look in the dictionary"); or his "scope" is at fault, and the contributing cues of the present situation do not operate, or some outstanding one leads him astray, as in the normal person who wrongly responds to the length of the line in the Müller-Lyer illusion.

Correct spelling, in other words, requires more than mere cue reduction. It also requires adequate scope or sagacity, which permits the *context* to play its part. For often words that *sound* alike should not be *spelled* the same way. Only cues from the context will enable the learner, however well "drilled," to apply his education effectively.

In the foregoing section we referred at one point to what we called "sufficient and proper practice." We have however given no account of what we mean by such terms. What is meant by "sufficient and proper practice" will become clearer in a later chapter.

The motivation of the learner. Before leaving the example of spelling we should pay some respect to the problem of motivation, although we have said that for the most part the problem in this case is in the process of drill or rehearsal. If we imagine the teacher undertaking to teach spelling to a young savage who has not already been taught to "go to school," to "get his lesson," to "bring home a good report card," or to be humiliated when his fellows laugh at his errors in spelling, the problem of motive would loom large enough.

Before getting under way at all, such a teacher would first have to discover in the life of the young savage some irritant, some distress, some anxiety or problem, which the act of copying a printed or written word would relieve. And this might not be easy. It would in fact be simpler to begin inflicting some sort of pain, from which the pupil could escape only by copying the word. Once the pupil discovered that copying the word was an effective technique or terminal act, reducing or abolishing this inflicted pain, or threat of pain, the teacher might at least feel that he was beginning to make some progress with his instruction, and cue reduction would rapidly take place, according to the laws of motivation, however foolish such teaching might be.

Modern life is so complex that it is difficult for the teacher of spelling to know precisely what the motives of his pupils are, in the spelling class, or elsewhere. But we may be sure they are present, or the first copying of the word would never occur, and no learning would take place. For, as we have seen, it is the relief of the initial irritant that ties the terminal act to the details of the situation causing it.

We have already intimated what some of the sources of motivation in the ordinary school child are. They are often almost as "artificial" in character as the threat of pain, inflicted by the missionary upon the hypothetical savage pupil. Learning to spell relieves the pupil from staying in after school; from the jibes of his fellows; from the bitter remarks of his parents; from the humiliation of ignorance; from the difficulties he has when he wants to write a letter to Santa Claus; and from a host of irritants which conspire to lead him tractably to school and to coöperate in the instruction there provided for him.

An important part of the work of instruction, even in the case of so rote a matter as spelling, consists in discovering what motives are available; in providing better, stronger, more natural and healthy ones; and then in tying up the course of learning with these better motives. Studies of the relative merits of different sorts of motivation will be considered at a later point in this book.

Errors in spelling. There are many kinds of errors made in the spelling of words, and this is not the place to discuss these details. One general feature of such errors, however, is so striking that we may here refer to it. The fundamental law of learning, cue reduction, or what has been called "serial shortening," the "omission of intermediate steps," is so definite that even the serial act of spelling a word shows it, in the incidence, locus and nature of errors.

Studies of the locus of errors in spelling,[1] in the case of learners, show the errors made to be distributed as follows, over the various positions (letters) in words of six and seven letters.

Earliest letters and the terminal letter show the fewest errors. The greater number of errors (omissions, substitutions, etc.) occurs with those letters just preceding the end of the word. No one explanation is adequate but the following consideration alone would lead us to expect just this result.

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[1] See, for example, L. S. Hollingworth and C. A. Winford, *The Psychology of Special Disability in Spelling,* Contributions to Education, No. 88 (Teachers College, Columbia University, 1918).

In a rather artificial sense the first letter of a word may be considered an initial irritant, a cue or stimulus, that is only relieved, dismissed or completed when the *end* of the word is reached. In study and rehearsal the letters 1, 2, 3, etc., have always led on to the final, the 7th letter. Letter 1 also has led to 2, 2 has led to 3; and 123456 constitute the total antecedent to 7.

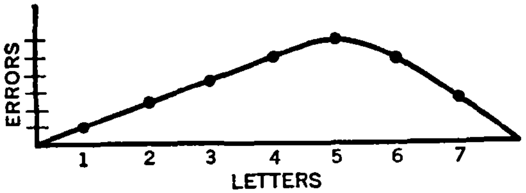

FIG. 15.—DISTRIBUTION OF ERRORS IN SPELLING.

Now letter 1 being given, each of the features of this complete antecedent, each of the letters, tends likewise to lead on to the terminal act, the last letter. The last letter thus tends to be produced earlier and earlier; the post-middle letters tend to drop out or to be wrongly given. Words thus wrongly spelled tend to be made too short, rather than too long, and the distribution of errors much resembles the pattern according to which the blind alleys drop out in the path of the animal in the maze.[2]

The teaching of geography. In the case of some "subjects" it is clearly enough recognized that nothing will take the place of raw experience, vital and concrete background, as the setting in which skills develop. In the teaching of carpentry, basketry, automobile driving, swimming, laundry processes, cooking, and the like, at least on the more elementary levels, this is commonly observed. Apprenticeship, or at least some type of "laboratory and shop" activity is the starting point.

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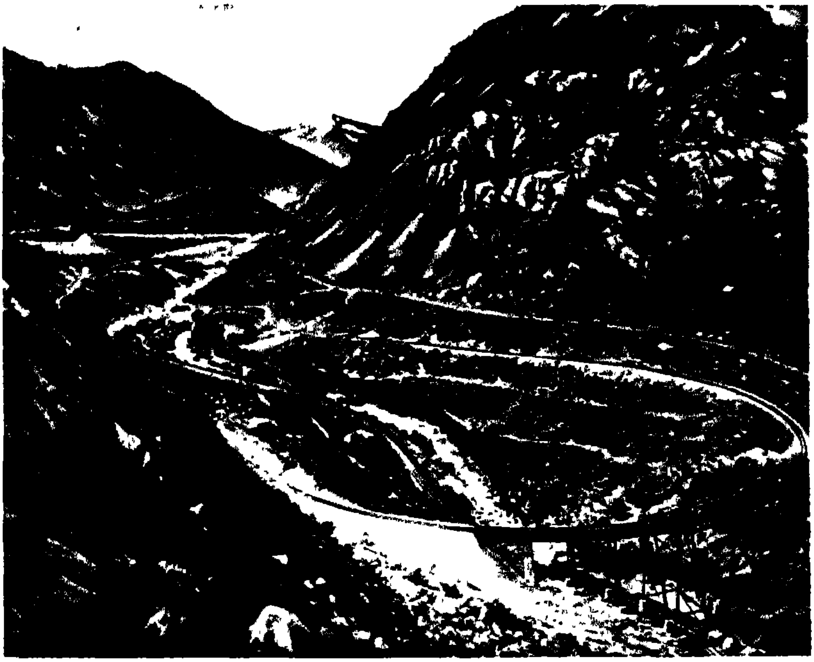
[2] Studies of the errors made by hand compositors have been adduced by way of refutation of this "omission of intermediate steps." But hand compositors are people who have been selected on the basis of their successful *resistance* to this tendency. They are no longer *learning* to spell. Such errors as they do make are as a matter of fact consistent with this general law though not strikingly so. The illustration is perhaps far-fetched at best, but in so far as it is significant, it is only in *learning* to spell that we might expect to find the results clear-cut.

In the case of geography this extreme case is by no means represented, yet no one would deny that perhaps the most effective way to teach geography would be by traveling about the world with pupils and giving them the "raw experience" of man's physical environment. In this way pupils might be first experienced with all parts of the globe and with all of man's activities, with natural flora and fauna. They could then be drilled in their "memories" of all these items so that experience could be made good use of on later occasions, when mere words or maps were presented. Some brief symbol for a situation might thus enable the individual to handle new problems in terms of the past.

But this sort of travel is not expedient, and the teacher has to resort to other methods of supplying the background for the cues that are to be made effective, and for the acts to which they are to lead. She may begin by making words and maps function for more elaborate situations. When this is done, through vicarious experience the pupils may be led to descriptions and pictures of parts of the world as seen by others.

Or "miniature worlds" may be made good use of. The children make maps of the school yard, of the neighborhood; they model mountains and peninsulas in sand, and these miniatures, in themselves *symbols* of a gross sort, may enable the pupils to give meaning to words, diagrams and "real maps." Factories, farms, ports, near by, are visited; museums are inspected; these "closely related" objects give meanings to descriptions of those objects to be learned about in distant regions.

A large part of the teaching of geography is thus made up of introducing the pupil to a larger background of experience, by *vicarious techniques.* But even this is possible only when such signs as words, maps, diagrams, numbers, pictures, have become potent to function for actual contexts encountered in the previous life of the pupil. This of course is what is meant by saying that the unknown must always be presented in terms of the known. This is the famous doctrine of "apperception" which was at one time a favorite term in educational psychology.



From Barrows & Parker, "The United States and Canada" (Silver, Burdett & Co.)

FIG. 16.—A PHOTOGRAPH OF REALITY REPRESENTING ONE OF THE EARLY STAGES OF CUE REDUCTION IN THE TEACHING OF GEOGRAPHY, ONE OR TWO STEPS BEYOND ACTUAL FIELD STUDY.

Assuming that all this has been accomplished and that the pupil has been given, or is being given, the wider acquaintance with the world which will freight these cues with definite "geographical meaning," there remains the technique of rehearsal, drill, and cue reduction. This must proceed to a point where judgments may be reached, decisions made, routes planned, and so on, without actually "going abroad," but with the aid merely of the reduced cues—the verbal statements, the maps, the diagrams, or the "thoughts of" the world's topography.

If we consider the topographical, place and location features as they enter into geography, the following stages may be indicated as representing increasing degrees of cue reduction in such learning:

(*a*) Actual exploration and travel
(*b*) Field trips through "typical" regions
(*c*) Sand maps, miniature geography
(*d*) Motion films and travelogues
(*e*) Photographs and still slides
(*f*) Relief maps
(*g*) Shaded and colored maps
(*h*) Outline maps
(*i*) The pupil's mental images and other memories of such maps
(*j*) Subtle verbal condensations and similar highly symbolic designations of fact and relation

The pupil is usually introduced to the topic on one of the earlier levels of this series, with concrete and "complete" materials in terms of which he makes his earliest "discoveries." He is then moved along the series, with cues more and more reduced, the materials becoming more "abstract," until a reasonable approximation to the final objective is achieved. Geography "tests" utilize the more reduced cues, in order to see their effectiveness in producing responses appropriate to the concrete situations of which the cues are "symbols."

Sample geography lessons. A few sample "exercises" and "projects" from a textbook in geography will serve to make this analysis concrete.[3] Here is what is called an "assignment":

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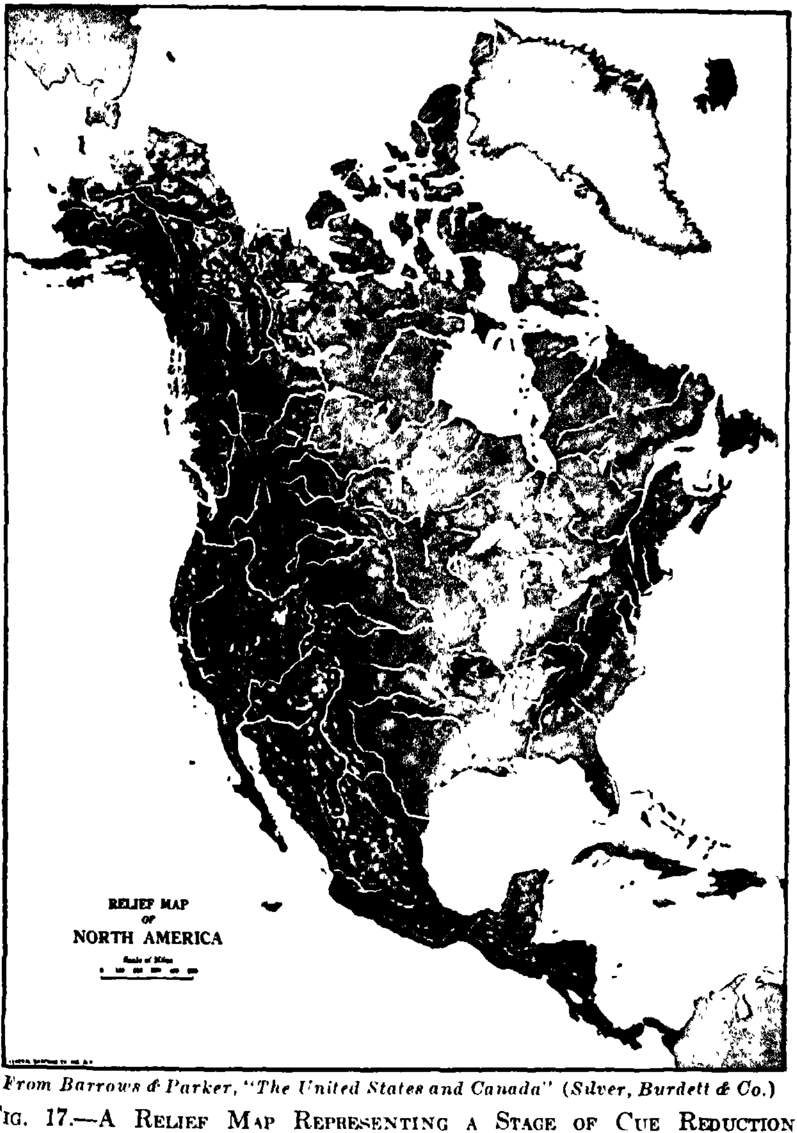
[3] All of the following illustrations are taken from Barrows-Parker, *Geography: United States and Canada* (Silver, Burdett & Co., 1925), pp. 88, 99, 120, 242.



From Barrows & Parker, "The United States and Canada" (Silver, Burdett & Co.)

Fig. 17.—A Relief Map Representing a Stage of Cue Reduction Later Than That Represented by a Photograph.

1. If you were to go due east from Montana to the western end of Lake Superior, what states would you cross? What ones if you went from northeastern Wyoming due east to the Mississippi? . . . From the map in Fig. 82 do you think you would see many mountains on these trips, or very few?

Consider now all that lies back of this assignment. The first explorer had actually to traverse this territory, noting the spots crossed, and the presence or absence of mountains. This would be "raw experience" in which the pupil cannot take part.

But the pupil has been introduced to situations, such as those represented in the "assignment," by looking at maps picturing mountains, by observing enclosed areas of different shape and color on these maps, to which the "names of states" are attached. These maps are reduced cues for the actual landscape. They are also accompanied by the text and by the verbal explanations of the teacher, thus giving to the pupil a highly elaborate context, much of it of the "vicarious" sort.

Now he is asked, from merely verbal cues, to name the states passed on the journey. He cannot travel across the country, finding out. He may revert to the map. Or cues of memory, imagery, verbal and kinesthetic patterns, may enable him to read off the correct replies. The goal sought is for these very reduced "internal cues" to do the work, so that the student can answer the question without "looking it up," just as, from the maps, he first learned to do it without "making the journey."

In the map referred to, no mountains are pictured. Instead, the various regions are shown in color, varying in shade with the general elevation. An accompanying code shows that certain shades mean certain elevations. Ideally the student by merely "looking at the map" passes his verdict concerning mountatins. Originally he had first to consult the code and compare the verbal explanation with the map shadings. And the verbal explanations, in turn, were symbolic cues, functioning for earlier experiences of elevation and depression in the landscape.

Let us consider another example, this time one called an "exercise."

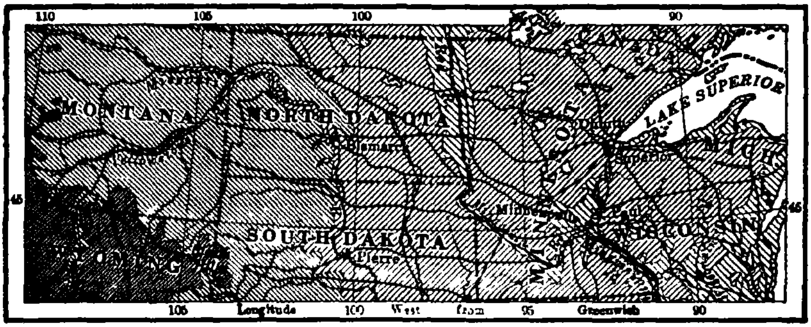


FIG. 18.—A SECTION OF THE MAP REFERRED TO IN THE FIRST GEOGRAPHY EXERCISE, REPRESENTING A STAGE OF CUE REDUCTION LATER THAN THAT OF THE RELIEF MAP.

Fill in the blanks in the following sentences and copy the paragraph in your notebook.

M........, I........, southernmost M........, southeastern S.......... D.........., eastern N.........., central and eastern K........, and north central and northeastern O........ are in the western part of the central .... f........ region. Most of this area is gently rolling land with good soils and enough rainfall for many kinds of crops. Among the crops raised there are ...., ..., ..., ..., and .... In addition men do much stock raising, stock feeding, and other kinds of farming.

Here is a neat example of the striving for cue reduction. The pupil has already seen the maps, seen pictures of the farms and the typical products, heard the teacher name these products, and perhaps brought bits of them to class and pasted them on the appropriate regions of the maps.

Now he is asked to state the products without these aids. He must "abbreviate the examination," just as did the pupil who was being taught to play the piano—one of our earlier examples. In the first part of the exercise, the initial letters are given, as persisting and directing cues, delimiting the range of response. Later on no such initial suggestions are offered. The pupil is more and more deprived of contributing cues; only the context and the names already pronounced can be relied on. The response must follow either from these bare contextual cues or from such cues as the pupil may be able to arouse within himself—visual pictures of the regions' names, vocalization of the names of the states, memories of the bits of materials pasted on the maps in earlier class work. The exercise is definitely a test of the degree to which such cue reduction has gone.

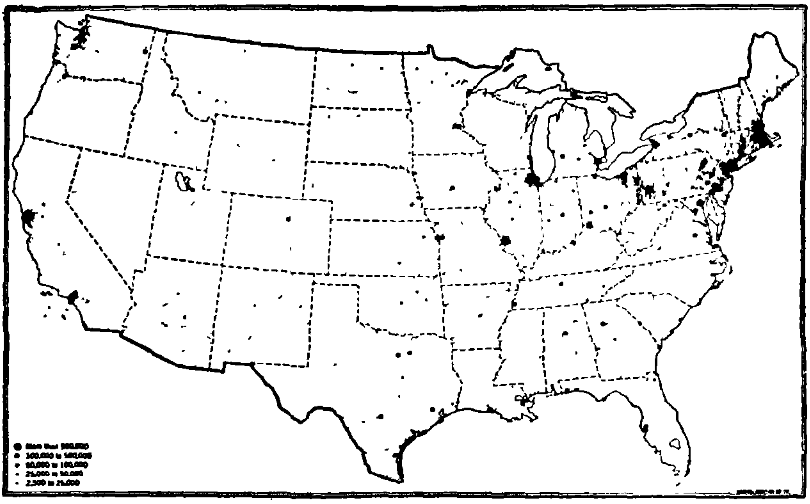


FIG. 19.—THE MAP REFERRED TO IN THE THIRD GEOGRAPHY EXERCISE REPRESENTING A RELATIVELY LATE STAGE OF CUE REDUCTION.

Here is another project under the heading "Things to Do."

> Find on the map in Fig. 120 (p. 97) the part of the United States between the Rocky Mountains and the Mississippi. Are there more towns and cities in the eastern part or in the western part, of this section of the United States? What have you learned about this section which helps you to explain this?

Examination of the map referred to shows a mere outline, in black, of the United States, with dotted lines outlining the states. No names occur on the map, there is no representation of the Rocky Mountains nor of the Mississippi, no rivers are in any way represented, but towns are indicated by points or dots of varying size.

The pupil must recognize which direction on the map is east, which part is the Rocky Mountain region, where the Mississippi is, merely by the *spatial relations* of the lines composing the outline map. But all these responses formerly required a much more elaborate context or antecedent. This antecedent is now being reduced to a point where the faintest sketch of a map will serve to instigate the effective response. In a still later stage, which is clearly being moved toward in such an exercise, even this sketchy diagram would not be needed. The student's "memory maps"—his spatial images, his gestural representation of directions, eye movements standing for locations, and the like, would suffice. In fact he is being so trained that such reduced cues as he *carries about with him* everywhere will serve to determine his conduct with reference to broad sections of his native land.

Here is another random exercise, chosen from many similar ones which any textbook on geography is likely to contain.

> Cover the title of the map, and carry the book along the aisle so that each of the pupils sitting in one row can see the map whose title is hidden. One person in each row is "passer." Each of the other pupils glances at the map as it passes, decides what he thinks the map shows, and writes down .... whatever title he decides upon. The winner of the game is the one who names the greater number of maps correctly.

Here is a clear enough case of determining to what degree the pupil has become capable of making a certain response (writing the correct name) in the presence of a reduced cue. Originally the map *plus* the seen name, *plus* pronouncing it, served as the cue to this writing response. Now the test is to see if learning has occurred—that is, if the mere sight of the outline map is a sufficient cue to evoke the correct response.

We see here also the way in which this geography work is being linked, by the teacher, to fundamental drives and motives. Being able to give many correct names in response to this reduced cue is a technique which enables the pupil to save himself from the ignominy of "losing" in the game.

The technique of instruction. We may finally sum up what we have said about the teaching of geography in the following words. The problem of teaching geography is that of:

1. Finding or providing a context of such a sort that the desired response will be evoked by the total situation
2. Presenting this situation vividly and repeatedly until the detailed elements of it, or certain specific details, become effective in evoking the same response
3. Knowing beforehand what details are the ones which in actual life are likely to be present when this response is needed, and seeing that they become the effective cues
4. Securing adequate motivation for such a learning process, so that cue reduction most effectively occurs
5. Determining by testing from time to time the point at which this particular detail or these particular details have acquired the desired effectiveness

Since we have used spelling and geography merely as samples of the technique of teaching, and since it has been suggested that a similar analysis may be applied to any teaching or educational project, it will be instructive for the student at this point to undertake such an analysis of instruction in the case of some other subject or project with which he is familiar.

PROBLEMS

1. Enumerate other "desirable acts" and relate each to the stimulus that is supposed effectively to produce it, as the result of education.

2. Take some school subject not mentioned in the chapter and show how an early step in teaching it must be the provision of adequate background, or "vital experience."

3. In the diagram on page 140 substitute actual items for the facts abstractly indicated as *A, B, C, D* and *T*.

4. Show how "vicarious experience" might be provided in teaching geology; history; economics.

5. Show that the teaching of elementary arithmetic involves (*a*) selection of desired responses to (*b*) specific stimuli or situations, (*c*) on the basis of concrete background experience, (*d*) through increasing degrees of cue reduction.

6. Analyze the teaching of penmanship by the method here used for the analysis of the teaching of spelling and geography.

7. Show how the memorizing of lists of events in routine history, or of states and their capitals in routine geography, exhibit the typical process of cue reduction.

8. Why is foreign travel supposed to have such a high educational value?

9. What "vitalized background" would be useful in teaching educational psychology?

10. What forms of "vicarious experience" might be used with profit in the teaching or learning of general psychology? Abnormal psychology? Psychology of childhood?

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CHAPTER VIII

GENERAL FACTORS ON WHICH LEARNING DEPENDS

Qualitative and quantitative studies. Experimental studies of learning fall into two large groups. *Qualitative* studies, such as those we have already referred to from time to time, are interested mainly in (*a*) the pattern of learning, (*b*) the nature of the antecedents and cues that are involved in it. and (*c*) the various kinds of responses and the changes that occur in them, as the result of the working together of various cues. *Quantitative* studies of learning, on the other hand, are more concerned with the time relations, the quickness and permanence of learning, and the way learning varies with changes in the frequency, the intensity, the vividness, and the arrangement of the training. In this chapter we shall pay attention to some of the general factors of this quantitative sort—factors that influence the *ease* with which learning takes place.

Such quantitative questions as the following arise in connection with any act of learning, such as code learning or learning to play the piano, or learning a vocabulary or an act of skill. These are only samples of a great number of such questions that have been investigated by experimental methods. All of them have a very direct bearing on the work of the educator.

Typical quantitative problems.

1. How promptly does the response, the consequent, follow upon the stimulus, or cue?
2. How does this time interval vary with different circumstances?
3. How many repetitions of the experience are necessary for a given degree of cue reduction to take place?
4. How is this accomplishment modified by the rate, the distribution, and the arrangement of such repetitions?

5. How is it influenced by various activities that intervene between the different repetitions or experiences?

6. How does it vary with the type of material and with the method of instruction?

7. When a given cue has once been made effective, does this effectiveness change with the lapse of time?

8. What differences are found between different individuals or among different species, in these quantitative results?

9. How are the quantitative aspects of learning modified by age, by distraction, by illness, by physical influences, by drugs, by competition, and so on?

10. What techniques of training are most effective for quick and permanent learning?

Such questions are almost endless in number and variety, because the *variables* are themselves so numerous, and vary so much in degree, and so many different combinations of circumstances are possible. We cannot hope here to summarize all the results of such quantitative studies of human and animal learning. We shall give only a general indication of their nature and state some of the more firmly established and valuable results; and we must limit our account chiefly to the studies of human learning.

Studies from which results may be derived. There are available studies of the acquisition of simple manual and sensori-motor skill, such as that involved in hitting a target, eye-hand coördination, ball tossing, juggling, and more complex performances such as typewriting, telegraphing, learning foreign languages or vocabularies. There are studies of learning in problem-solving situations, such as solving mechanical puzzles, working out riddles, the mastery of tools and machines. There are many investigations of the mastery of verbal series, as in the learning of prose and poetry, arbitrary combinations of words and numbers, and combinations of numbers, words, colors and the like with other sorts of objects.

Many experiments have been conducted on learning in more highly "symbolic" situations, such as learning to read, learning the fundamental processes in arithmetic, learning the content of special fields of knowledge—as history, physics, algebra. And there are many closely controlled studies of learning in "test" situations, as in the code-learning substitution test which we have already described. Many separate volumes in the literature of experimental and educational psychology have been devoted exclusively to the description, analysis and measurement of the learning process.

It will be convenient to base our first expositions on some sort of learning, in which the process can be clearly defined, and in which the conditions can be rather carefully controlled and varied. For this purpose we shall usually choose the learning of a code as it is illustrated in the substitution test of which we have given a printed sample on an earlier page.

Curves of learning. In a quantitative study of learning we pay no attention to the qualitative changes that may occur. A definite response or act is called for, and this is made by the learner, from time to time. We know that improvement in this process will depend on a gradual reduction of the cues that provoke the act in question. But we give no heed to this process and do not care particularly what the cues are that produce the act. We keep the general situation as constant as we can and simply measure the "efficiency" of the performance, as measured, for example, by the number of times the act can be done in a given time, or by the time required for each performance of the act.

It is convenient to represent the results graphically, in the form of a curve, drawn with reference to a horizontal and a vertical axis. Along the base line we may represent the successive trials or observations. Along the vertical axis we represent the measure used, as for example, the time required for the act to be completed. For each trial, as shown on the base line, we record the time required, by measuring off a distance along the vertical line, and, on coördinate paper, recording this above the trial in question. We thus construct, by joining the successive points or measures, a curve which shows clearly how the time measure varies in the successive trials.

Typical learning or practice curves. Curves of this kind are commonly called learning curves, or practice curves. In order to illustrate the nature and use of such curves, there are given, in one chart, learning curves for three different tasks, secured from adults (college students). The activities were practiced in 15 different sittings; in each sitting quite a number, and always the same number, of performances of the act were accomplished. Since the time for any *single* trial will be quite variable, because influenced by so many different factors, taking the total time for a fixed number of trials at each sitting serves to reduce the irregularity. For when many trials are thus taken together, the outside influences in which we are not at the moment interested tend to neutralize one another,

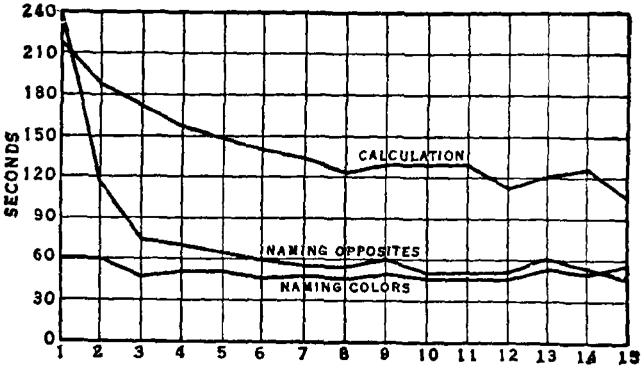

FIG. 20.—LEARNING CURVES FOR THREE DIFFERENT TASKS.

and our total measure gives us a fairer indication of the general tendency. This will be clearer if we now describe briefly the activities that were practiced.

One of the activities was color naming. On the test sheet were one hundred small square patches of color, printed in rows. There were only five different colors, but each appeared twenty different times on the page. Their arrangement in the rows was irregular and random, and was changed at each trial. The learner was required to call aloud the name of each color as he came to it. If he made an error the experimenter quickly said "No" and required the subject to give the correct name before going on. This sounds like a very simple act, and one which might indeed not require any "learning." But the learner was required each time to name the colors as *quickly* as possible. One who tries to do this will be surprised to see how slow the process is, even though he "knows" the familiar names very well. It is true that in this particular act these adults did not show much improvement; but in the case of children the improvement that can be made is very noticeable. For our present purpose we choose color naming just because adults do not show much improvement. This enables us to contrast this activity with others in which the improvement is more considerable.

A second activity practiced in this experiment was naming opposites. A list of fifty familiar adjectives (such as loyal, aristocratic, conservative, shallow, etc.) was presented on the test sheet. The learner was required to look at each word and call out, not this word, but the word that has just the *opposite* meaning. Thus, seeing "shallow," he might respond by "deep" or by "profound." In each trial the same words were used but always in a different order.

The third activity was calculation—mental addition. There appeared on the test sheet fifty two-place numbers (such as 37, 65, etc.). In each sitting the same numbers were used, but always in a new order. The learner was required, each time, to *add 17* to each number in turn, and to call out the sum. The adding had to be done each time "in his head." In this as in opposites and color naming, a correct response was required each time. The "score" at each sitting was the time required for a perfect performance.

In order further to eliminate the influence of chance factors, the results from ten different people are averaged, for each trial. The curves as here shown give therefore, for each sitting, the average time required by these ten learners to complete the task with no errors. Curves for single individuals will show the same tendencies as these averages, although they will differ somewhat from one another and will be more irregular. In actual educational application of such results it is important to know not only the general tendency but also the characteristic learning curve of the individual pupil.

The characteristics of learning curves. Taking these three curves as samples of the hundreds or thousands of such curves that have been established, we may note the following general characteristics. We shall consider only those characteristics which are in general common to all curves of learning, using these as our illustrations, not as final demonstrations.

1. *Different processes yield different learning curves,* at least under a given set of conditions. It will be seen that the curve for color naming is scarcely to be called a "curve" at all—it is almost a horizontal line, running across the graph, from trial 1 to trial 15. Yet there is a slight indication of improvement; the first trial was the slowest of all, and with successive trials a slight gain is made. The curve for calculation is also nearly a straight line, but it has a very steep slope, running from a very slow performance in the first trial to the very best or quickest performance in the last trial. And considered as a curve, it is slightly concave rather than convex—that is, improvement is a bit more rapid in the earlier than in the later trials. The curve for naming opposites is very concave indeed. At first improvement is very rapid, from trial to trial; then it becomes less rapid; by the ninth trial the curve has almost "flattened out," although as a matter of fact improvement is still going on and the very last trial was best of all.

2. In general, *learning of a specific thing shows a "law of diminishing returns."* That is, the curves tend to be concave rather than convex; the first few trials result in more marked gain, as measured by time required. In subsequent trials improvement tends to be less and less, until finally something like a final level, called the "practice level" is reached.

3. *Differences between processes,* and *differences in the amount of previous learning* are mainly responsible for the

differently shaped curves. To take the second of these first, we might suppose that college students have already had a great deal of previous practice in naming colors; not so much practice in adding; and still less practice in calling out the opposites of adjectives. We might take the three curves here shown and consider them different sections of a single long curve; the first section would be that for opposites; attach to this a slope like that of the curve for calculation, and finally add a long gradual slope like that of the curve for color naming. There would thus result a single long curve, declining rapidly at first, then more slowly, and finally scarcely at all. And these three sections would represent only different stages in a very long learning curve. This would give us a still better notion of what a typical curve of learning would be like, beginning with a stage of almost no practice and ending practically on a practice level.

But it is also true that, aside from previous practice, different activities may yield different curves of learning because of their differences in complexity, because of differences in what the learning consists in, because of different points in the course of learning at which past gains can act in a cumulative way, and so on.

In color naming, for example, the task is only that of speaking quickly a well-known name. In opposites the task at first is chiefly that of finding or discovering just what the precise opposite of a given word is, and only in later trials does the process become that of simply speaking the proper and "now known" word quickly. In calculation a process of "mental calculation" must at first be gone through each time even before the answer can be "discovered," and this "preliminary examination" must become abbreviated before the various other sorts of cue reduction can occur.

In other words "speaking time" plays a very large rôle in color naming; a smaller rôle in opposites; and a still smaller rôle in calculation, in the beginning. As time and practice go on, the three processes come to resemble one another more and more—each represents only the time required for a subtle cue to produce a speaking response. But these very differences in the processes, as we now see, may be considered due to different amounts of previous practice.

4. *Plateaus sometimes appear* in learning curves. By a plateau is meant a relatively flat stretch in a curve which is on the whole changing. This means a succession of trials in which improvement is held up or delayed. Further improvement may therefore appear as a rather sharp drop from this plateau. Plateaus are more likely to be observed definitely in the curves of individual learners. But even in our average or "smoothed" curves we can find such indications, which will at least serve as illustrations of what the plateaus are like. The curve for calculation, for example, falls quite steadily up to the seventh or eighth trial. Then comes a fairly level stretch, lasting from the eighth to the eleventh trial, in which no improvement is made. But by the twelfth trial gain appears again, and rather suddenly. Similarly, in naming opposites, a plateau from the fifth to the ninth trial is rather abruptly departed from at the tenth trial and thereafter does not appear.

Plateaus in learning curves may mean various things. They may mean that the learner has ceased to make effort for a time; that he has adopted a method which will not carry him further; that only some *new technique* will serve to advance him, and until this new technique is adopted gain will not appear. Plateaus may mean only periods of discouragement, or periods in which motivation lapses; they may mean that gain is actually being made, but in such a way that it does not show up in the score. Thus a tennis player may be actually improving, and yet, since the score is kept roughly in sets, games, or points, the score card may not show his improvement until it reaches a point which will secure him an additional whole unit in the score.

In educational psychology the thing that has usually been emphasized about the plateaus is the fact that they do not necessarily represent final limits of proficiency. The learner and the teacher should understand that, unless the plateau represents an actual physiological limit of proficiency, advance may still be made beyond it. The plateau should not be allowed to discourage the learner, nor to cause him to rest content with his present efficiency; instead it should constitute even a stronger challenge to effort, to analysis of procedure, to renewed motivation, and to perfection of technique. The world is full of people who rest content on plateaus of proficiency, which by no means represent the necessary limits of their attainment.

5. *There are three kinds of practice limits.* The importance of distinguishing between a plateau and a practice limit makes it necessary to consider the various kinds of practice limits. At least three are .important, which we may call (*a*) the knowledge limit, (*b*) the motivation limit, and (*c*) the physiological limit.

The knowledge limit represents a level of performance which, for a given individual and material, is the best that can be achieved by the *method* then employed. Thus, by the "eye and finger" method, there is a limit to the rate at which I can type. If I know no better (knowledge limitation) than to continue by this method, my performance can improve but little, if at all. But by adopting the "touch" system my performance might in time much exceed this standard.

The motivation limit depends upon the zeal or effort the individual brings to bear upon the performance, rather than the amount of information. The effectiveness of learning depends, for one thing, upon the vigor of the motive prompting it. To "do one's best" is always a variable, depending, for one thing, on the inducement or motivation of the act. People are often surprised that under pressure of excitement, fear, rage or competition they may reach levels of performance to which ordinary interests had failed to carry them. Even a long continued and apparently final level on a curve of learning may often be left behind and a superior level attained through adequate motivation, fresh enthusiasm, by a change in the vigor of the irritant which the act relieves.

Beyond these limits there is a necessary limit set by the structure of the organism, by the physiological and physical conditions and instruments of activity. Muscles have fixed ranges of contractility, bones their unalterable arrangements and leverage. Beyond the limits set by the speed of nervous impulses, latent times, reaction times, and so on, the fingers, hands, eyes, speech organs, sensory activities, cannot go. Perhaps there is even a limit to "the time of thought." The significant thing for education is the fact that what are ordinarily called the limits of performance are usually examples of the knowledge and the motivation limit, rather than the physiological limit.

The teacher's use of learning curves. Practice curves were originally drawn in order to study the course of learning and in this way to derive general principles. But they may also be put to many practical uses by any teacher who has the time to work them out, or who can enlist the aid of the pupils in recording in this way the course of their improvement. The curves must of course be based on the measurement of equal samples of work, or on the performance of some fixed act.

Thus in teaching typewriting it is easy and very instructive to keep from day to day a record of the time and errors in the reproduction of some standard passage. In physical education, where changes produced by training are likely to be very slow and often inappreciable to casual observation, keeping of such records as time to run 100 yards, number of times chinned, pounds squeezed on the dynamometer, chest expansion from day to day, may play a useful pedagogical purpose. In addition to informing the teacher of the rate of improvement, of the periods of plateaus, of the need for special effort, of achievement as compared with other groups for whom similar graphs have been recorded, the curves may serve useful purposes for the learner as well.

They inform him in undoubted terms of his rate of progress; often he can relate slumps or rapid advances to changes in his method, to adverse influences, and the like. The curve also affords a useful and constant, healthy motive—namely, the invitation to compete with his own record.

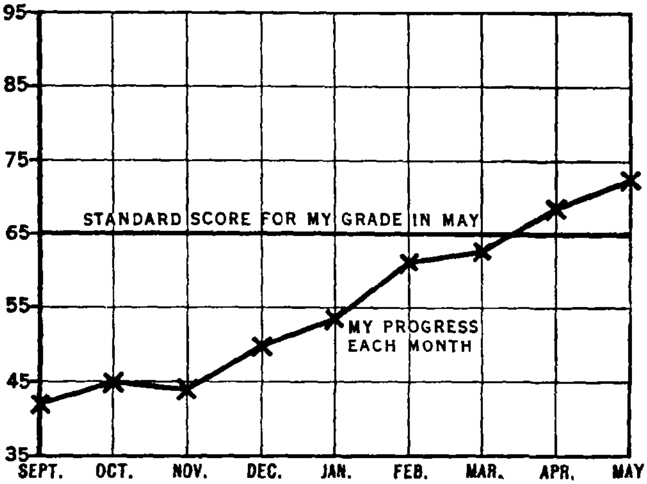

Fig. 21.—The Practice Curve as an Aid to Motivation in Penmanship or Other Objectively Measurable Work.

Learning as related to age. The quantitative results considered so far have been based on the average performance of groups of learners in order not to introduce the irregularities that are due in part to the peculiarities of different learners. These peculiarities, or individual and group differences, now become our chief concern, and we begin with the very noticeable fact that learning ability varies with the age of the pupil. Common sense has many expressions for this obvious fact. That learning ability varies in measurable and definite ways, however, does not appear in the general common sense belief, which does not attempt to indicate the magnitude of age differences, nor their precise relation to age.

We shall use the code learning (substitution) process as the basis of our account. What holds here is also true of learning of other kinds. The test sheet is shown on page 19 and the instructions are there given also. In the following graph is shown the way in which the time of performance varies with age, from 4 years to 16 years. Since the actual writing of the numbers can be done about equally quickly at almost any of these ages, the age difference is due in the main to differences in the ability to learn the code, from the key at the top of the page, and, by reducing the cue, to get free from the necessity of relying on this key in later parts of the sheet.

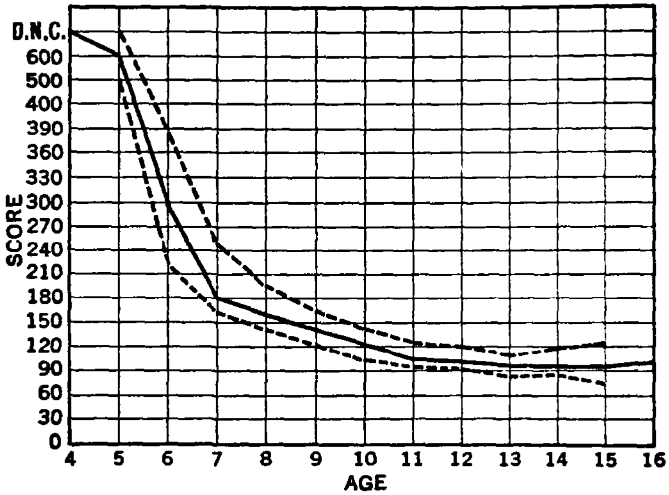

FIG. 22.—CHANGE IN CODE PERFORMANCE WITH INCREASING AGE.

From Pintner and Paterson, *A Scale of Performance Tests* (D Appleton and Company, 1917), p. 134.

In the graph the heavy middle line shows the average time, for different ages, this time being the average of a number of children at each age, so that all differences except those due to age may so far as possible be allowed to balance one another. The upper dotted line shows also the 25 percentile, and the lower dotted line the 75 percentile. Half of the individuals, at a given age, will fall between these two points; one-quarter will be as good as, or better than, the record shown by the lower line; one-quarter will be as slow as, or slower than, the time indicated by the upper line.

The time required, and therefore the speed of learning, since none of the learners knew the code to start with, changes definitely with age. If decrease in time means increase in learning ability, then learning ability increases rapidly from 4 to about 10 or 11 years, then less rapidly, and tends to level out at about the age of 16 years. The general shape of the curve, although different groups of learners are shown, and at intervals a year apart, is very like that of the curve of learning for the same individuals at intervals much closer together, as we have seen them in the foregoing sections. On the whole, then, we may say that learning-ability as thus measured increases by a regular curve, the rate of increase gradually becoming less and less, until a maximum is reached somewhere beyond the 16th year.

Decline of learning ability in adults. The maximum degree of learning ability appears to be reached on the average at about the twentieth year. Some individuals reach their maximum earlier than this, and some no doubt much later. In the following graph are shown the scores in the substitution test in the case of groups of individuals ranging in age from 7 to 50 years.[1] The individuals at each age are different persons; up to age 16 they are representative groups of school children. Beyond that they are groups of men who, in various other tests of mental ability, did not show any variation with age, and may therefore be safely compared, age for age, in learning ability.

It will be noted that in this graph increase in learning ability is shown by a rising line, and decrease by a falling curve. This is because here instead of setting a fixed task and measuring the time required, a fixed time was set and the measure was the number of items done in that time. Either instructions are there given also. In the following graph is shown the way in which the time of performance varies with age, from 4 years to 16 years. Since the actual writing of the numbers can be done about equally quickly at almost any of these ages, the age difference is due in the main to differences in the ability to learn the code, from the key at the top of the page, and, by reducing the cue, to get free from the necessity of relying on this key in later parts of the sheet.

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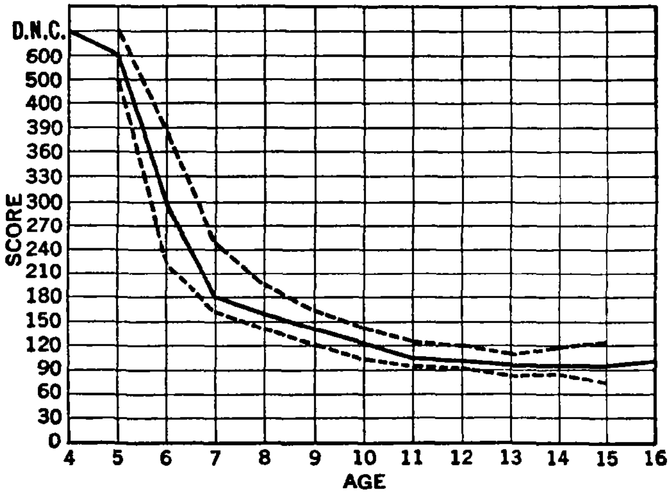

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It will be noted that in this graph increase in learning ability is shown by a rising line, and decrease by a falling curve. This is because here instead of setting a fixed task and measuring the time required, a fixed time was set and the measure was the number of items done in that time. Either way of graphing a practice or age curve is legitimate. There is some advantage in measuring in terms of time. For since learning consists in cue reduction and shows itself in reduction of the time required for a given act, the shorter time is a useful symbol for the smaller cue.

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[1] The records up to the twentieth year are adapted from Pintner and Paterson, *A Scale of Performance Tests* (D. Appleton & Co., 1917). For later ages the data were secured on men, and first published in H. L. Hollingworth, *The Psychology of Functional Neuroses* (D. Appleton & Co., 1920). See also H. L. Hollingworth, *Mental Growth and Decline* (D. Appleton & Co., 1927).

The graph shows that after 20 years a gradual decline in learning ability appears. In this curve the men studied, at age 50, had declined to a point where they were just about equal to average 12-year-olds in this respect. Other studies have been made of the learning ability of persons up to the age of 70 or more, and on the average this curve of decline continues to fall in a fairly uniform way so far as it has been recorded.

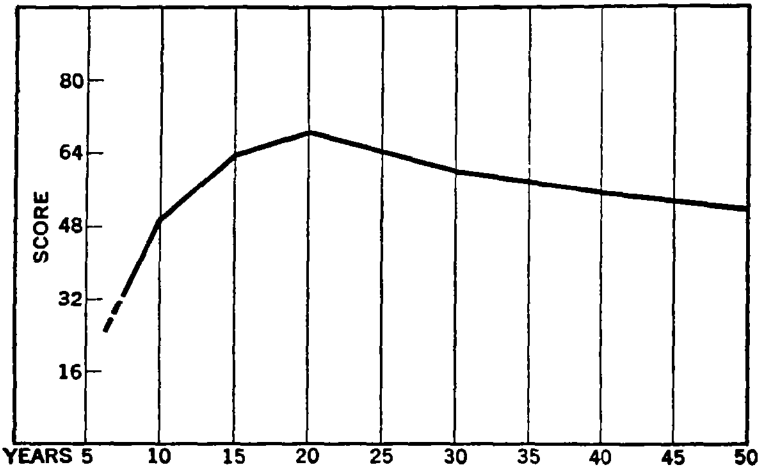

Fig. 23.—Age Curve for Code Learning.
(After Pintner and Hollingworth.)

In recent years the interest in adult education, and the increasing number of aged persons in the population, have led to a great number of studies on the perception, learning and memory of grown-ups. Several such studies were made by Thorndike, who sums up his results in the following words:

> The general tendency from all of our experiments is for an inferiority of about 15 per cent as a result of 20 years from twenty-two on. Learning, representing an approximation to sheer modifiability, unaided by past learning, shows considerably more inferiority than

this. Actual learning of such things as adults commonly have to learn shows considerably less.[2]

Willoughby also used a code-learning test on all the available members of a population ranging from below 10 to over 70 years of age. The curve, which is here shown, closely resembles the one we have given for the substitution learning test, "Ability seems to rise sharply and regularly from the earliest age at which a score is possible to a mode at about 21 years, and then to decline gradually to old age."[3] In this curve the score at 70 years is about equal to that at 5 years.

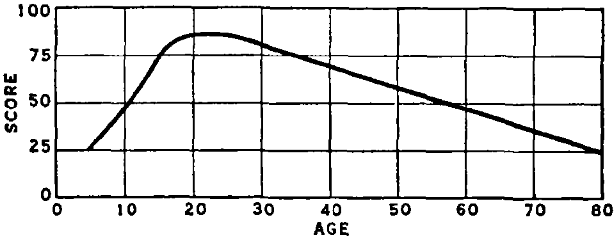

FIG. 24.—AGE CURVE FOR CODE LEARNING (From Willoughby).

It is interesting that common practice has chosen the age of maximum learning ability as approximately the age of legal maturity, and that the greater part of our school programs are undertaken during the years when learning ability is either on the increase or at its maximum. But it is also worth noting that learning ability is present throughout adult life, and that at the age of 50, human beings are as able to learn new material as they were at the lively school age of twelve years. It is this fact, among others, that has given the movement for adult education its hopeful outlook.

Individual differences in learning ability. Even when different learners are of the same age, and when the utmost care is taken to keep constant such things as the amount of previous learning, motivation, and the general conditions of the experiment, notable and important differences are found. Again using our code-learning substitution test as a measure, there is here given a graph showing the distribution of the scores of 100 college freshmen, all women. In order to make this graph intelligible it will be necessary to explain the unit of measurement shown on the base line. This is the "probable error" of the distribution, a unit much used in mental and educational measurement.

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[2] From E. L. Thorndike, *Adult Learning* (1928). By permission of The Macmillan Company, publishers. See also Hollingworth, *Mental Growth and Decline*.

[3] R. R. Willoughby, "Incidental Learning," *Journal of Educational Psychology*, December, 1929, and January, 1930.

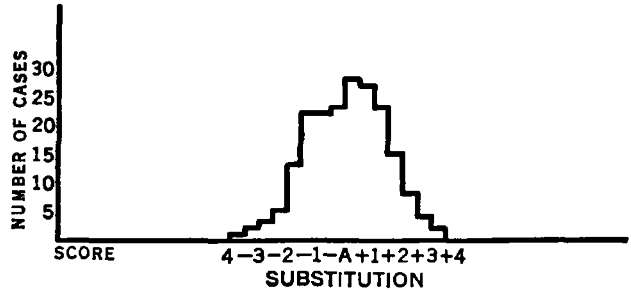

FIG. 25.—LEARNING ABILITY OF COLLEGE STUDENTS.

From F. E. Carothers, "Psychological Examinations of College Students," *Archives of Psychology,* No. 46, 1921.

The average time taken by these 100 college freshmen for this act of learning and achievement is 196.6 seconds. Their individual times are of course very different from one another, and they are grouped about this average. If we take a time which is 14.4 seconds less than this average (182.2 seconds) and also a time which is 14.4 seconds more than the average (211.0 seconds), it will be found that just half of the 100 freshmen have scores within these limits, that is, somewhere between 182.2 and 211.0 seconds. This distance, 14.4 seconds, which it is necessary to go above and below the average to include the scores of half the cases, is called the "probable error" of the distribution or graph.[4]

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[4] Various similar statistical measures are in common use, and their precise meaning varies with the measure used. For our purpose it is not necessary to go into these details, which the reader will find discussed in volumes on mental and educational measurement.

Now instead of marking off the base line for the graph in seconds, the unit used is 1 P.E. (one probable error). That is, each unit on the base line is 14.4 seconds. With this in mind the graph should now be intelligible. The different scores range from about 4 P.E. below the average to about 4 P.E. above it. These 100 college freshmen therefore differ widely in their learning ability as measured in such a performance. The variations in ability with groups lower in academic standing, that is, children in the lower school grades, will vary even more widely than this, for they will include many whose learning ability is so poor that they could never meet the requirements of learning and knowledge that are set for college freshmen.

It will be observed that this graph shows a fairly symmetrical curve, tapering off from the average in both directions. Most of the scores are rather close to the average. As one goes away from the average in either direction the number of people becomes less and less. A symmetrical bell-shaped curve of frequency of this sort is commonly called the "normal surface of frequency" or the "normal curve of distribution." Measurements of nearly any human trait, made on representative samplings of the population, show a distribution of this form. This is true, for example, for such traits as stature, strength, weight, eyesight, intelligence—indeed for practically all characteristics.

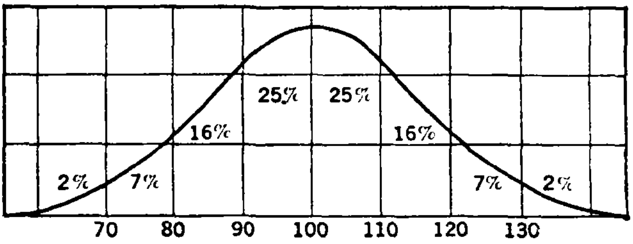

FIG. 26.—SHOWING THE DISTRIBUTION OF LEARNING ABILITY IN THE GENERAL POPULATION.

Frequencies are indicated for various ranges of the learning scale, 100 being average or normal, and the "probable error" being 10.

It is instructive to consider such a curve in the abstract, laid off on a base line with probable error units, and to consider how many members of the group would on the whole be expected to be at each region of the graph. A curve like that of Figure 26 is approximately what one would expect. In each section is indicated the percentage of the population that would be found in that region, or with that degree of ability. The tabulated results would be as follows:

Score	*Approximate Percentage of Cases*
Between − 4 P.E. and − 3 P.E.	2
Between − 3 P.E. and − 2 P.E.	7
Between − 2 P.E. and − 1 P.E.	16
Between − 1 P.E. and average	25
Between average and + 1 P.E.	25
Between + 1 P.E. and + 2 P.E.	16
Between + 2 P.E. and + 3 P.E.	7
Between + 3 P.E. and + 4 P.E.	2

In general then we may conclude that pupils will be found to differ in learning ability quite as they do in other traits. In terms of actual amount, indeed, the differences are greater the more subtle, the more mental, and the more complex the trait. Thus although in stature a group of college freshmen will differ according to such a symmetrical curve as that shown for learning ability, the probable error will be small, and the tallest student will scarcely be more than twice as tall as the shortest. But in any group of pupils the learning ability of the best will be many, many times better than that of the poorest.

The importance of such enormous individual differences in learning ability for education has increasingly been recognized by the schools. In the setting of assignments, for example, it is clear that no set task can very nicely be suited to the abilities of all the pupils, unless these have first been selected and grouped in some way on the basis of their native learning ability. We shall see in later chapters how even the planning of curricula, the adoption of one or another method of instruction, and many other problems of school administration must be determined in part by the known facts about the range of individual differences in learning ability among pupils who appear in other respects, such as age, size, social status, to be very much alike.

Variations in the individual learner. Not only do different individuals differ from one another in learning ability, as in all other human traits; the individual himself is a variable system, and his performance changes from moment to moment. Influences in the surroundings, in the conditions of work, and also factors internal to the learner, such as degree of motivation, health, sleepiness, worry, and fear, may notably modify the ease of learning. We may therefore distinguish inter-individual variations (when different individuals are compared) from intra-individual deviations (when the same learner is observed on different occasions). By individual differences, in the strict sense, we should mean those that are constitutional or those found when the general level of performance of one person is compared with that of another, excluding the momentary deviations. It is not quite safe to say "*Once* a poor learner, always so"; but there is much truth in the assertion, "*Several times* a poor learner, nearly always one."

We may use the influence of a mild dose of alcohol, under experimental conditions, to illustrate the way in which numerous factors may modify the learning of the individual. Again the code-learning activity will be the thing learned. Six adults worked all day, for several days, at a variety of mental performances, including code-learning. In the forenoon conditions were always normal. At the usual time for lunch they were, on different days, treated in three different ways. On certain days they were given fairly large doses of alcohol, in a familiar beverage; on other days they were given a smaller dose of alcohol; on still other days they were given the same beverage, but with all the alcohol extracted. In the accompanying graph[5] are shown the work curves for these three kinds of days, the records of the six workers being averaged at each test in order to give more uniform and reliable results. The score was the amount done in a fixed time, so that lowered ability is shown by a fall in the curves.

The gap in the middle of the graph represents the noon hour, during which the dose was taken. The curves before and after this gap show the performance in code-learning before and after the various dosages. The broken line shows the result on "control days" (non-alcoholic beverage). The best records are made at the first trial, early in the morning. As the day goes on the curve shows a general drift downwards, thus serving to illustrate one of the typical effects of fatigue, the influence of previous sustained activity.

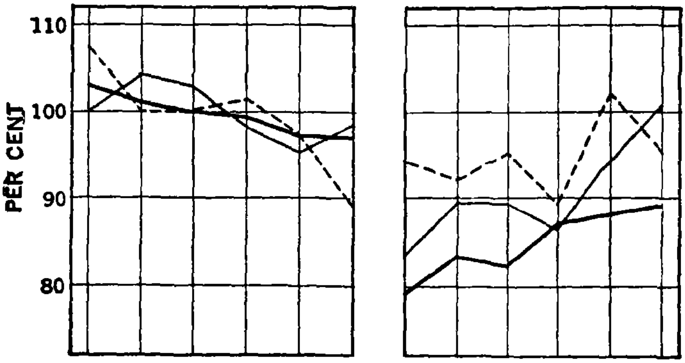

FIG. 27.—INFLUENCE OF ALCOHOL ON CODE LEARNING.
Average records. Heavy line, large doses; light line, small doses; broken line, control doses. Vertical scale represents score expressed as per cent of average forenoon performance Horizontal line shows six forenoon and six afternoon trials, and intervening lunch period. In this test lower score means decreased proficiency.

The light solid line shows the results on the days when small doses of alcohol were taken. The morning curve is the usual one. But after the dose the curve falls quite below the normal and remains there most of the afternoon, gradually rising so that by the end of the day the work is back on the normal level.

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[5] From H. L. Hollingworth, "The Influence of Alcohol," *Journal of Abnormal and Social Psychology,* October, 1923, and January, 1924.

The heavy solid line shows the results on days when larger doses of alcohol were taken. Again the morning curves are the same as before. But after the dose there is a very great loss of proficiency, which remains distinctly lowered throughout the day. Even at the end the ability is less than that on normal days, and on days with smaller doses.

Before the doses, in other words, the curves are quite alike. After the dose the curves definitely and reliably fall apart. The drug produces inefficiency in learning, and in such other abilities as are involved in performing the substitution test. The amount of such loss varies with the size of the dose, and only after a considerable time is the system able to recover from this disturbance.

Numerous other influences, such as those we have mentioned, may in the same way be shown to modify the capacity for learning and the rate at which it goes on, and these results are often easily measurable. The case of alcohol may be considered here simply as a single example of the facts, and of the way in which information of this sort is secured. In general it may be said that it is easier to introduce influences which will interfere with or lower the learner's ability than it is to find factors that will improve it by a similar amount.

Knowledge of such results should save the teacher from concluding at once that any difficulty in learning is due to the natural dullness of the learner. Care should be taken first to make sure that the fault does not lie in the circumstances or conditions under which the learning is being carried on. The educator should therefore become quite familiar with the known facts about the hygiene of work.

Lapse of time and the effect of disuse. Finally, among these general factors on which learning depends, we may consider the effect of disuse. By this we mean the lapse of time between exercises of the activity in which the learning took place. We shall first observe some of the experimental results, and later consider the explanation that is to be given for them.

It is well enough recognized that things once fairly well known, that is, learned, may slip away from us if we do not make use of them, exercise them, rehearse them. To only partly learn a thing and then to postpone training for a time, may mean that when training is renewed, it may be necessary to go nearly back to the beginning again and learn it all over.

The following curve, from a study of the memory of college students for the material they hear in lectures, gives a dramatic illustration.[6] Without being warned that this was to happen, different groups of students who had heard lectures on psychology were tested for their knowledge of what they had learned. Some were tested at the close of the lecture; others after different intervals ranging from a few days up to eight weeks. A careful experimental procedure was followed, so as to make the various comparisons well controlled and reliable.

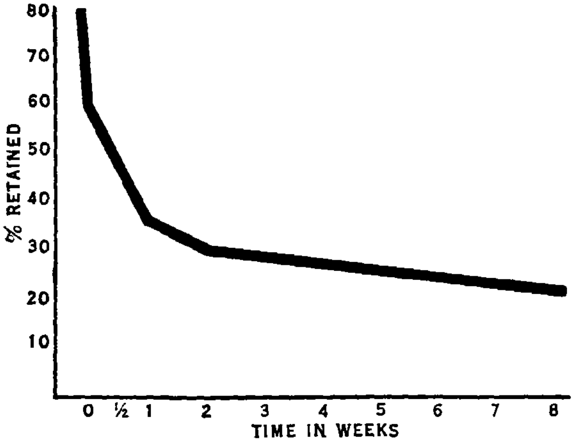

FIG. 28.—A CURVE OF FORGETTING MATERIAL IN LECTURE. (From Jones' *Experimental Studies of College Teaching.*)

The curve shows the amount retained after the different periods of time; this ranges from 80 per cent immediately after the lecture to 20 per cent after the lapse of eight weeks. A curve of this sort is commonly known as a curve of forgetting. Similar curves have been secured in the case of various kinds of school learning, such as arithmetic, botany, zoölogy.

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[6] H. E. Jones, "Experimental Studies of College Teaching," *Archives of Psychology*, No. 68, 1923

In some cases the initial fall in the curve is very steep. In the next graph shown is the first curve of forgetting that was experimentally derived by Ebbinghaus for the learning on lists of non-sense syllables. During the first day or two the fall in the curve is very steep, and thereafter more gradual. In another graph from McGeoch and Whitely (Fig. 30), a curve of retention for very meaningful material is shown. In such a case the slope of the curve is likely to be more gradual.

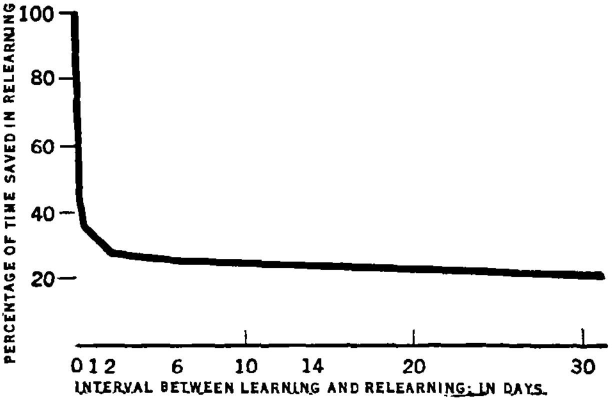

FIG. 29—A CURVE OF FORGETTING FOR NON-SENSE SERIES (Ebbinghaus.)

In general then, we may conclude that, if learning is not continued, the lapse of time (disuse) produces a loss of ability (un-learning), and that this loss varies in amount with the meaningfulness of the material. The more meaningful the material, the slower the loss.

Any technique of instruction that will retard this gradual loss of the results of learning should be welcomed. Jones, whose memory curve for items learned in a psychology lecture we have just given, experimented with the device of giving a brief and summary but fairly complete review examination during the closing minutes of the lecture period. Classes to whom these review tests were given were compared with those not receiving them. It was found that memory was fully 50 per cent better, for intervals ranging from three days to eight weeks, in the case of classes with whom the immediate test device or summary examination was used immediately after the close of the lecture. Any such device, that will increase the permanence of learning by 50 per cent, should be put to good use in teaching.

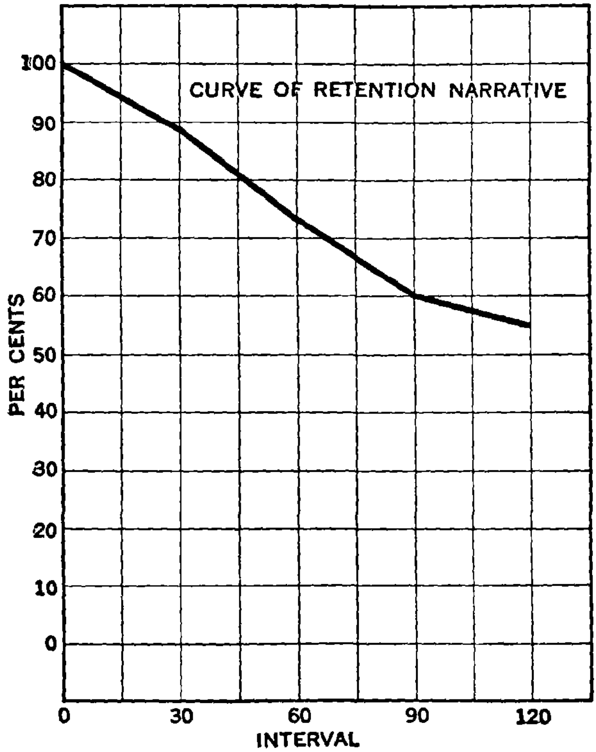

FIG. 30.—A CURVE OF FORGETTING FOR MEANINGFUL MATERIAL. (From McGeoch and Whitely, *Journal of Educational Psychology*, 1926.)

The psychology of forgetting. This outcome throws some light on what happens when we forget. Not only is non-sense material harder to learn than is material with meaning; with it un-learning is also more rapid with the lapse of time in which no *use* is made of it. The explanation is probably to be found in the answer to the question—"What do we mean by meaningful material?"

From the analysis of learning we have already given, it seems clear that meaning is the result of learning. It is through the process of learning that a detail, a sign, a cue, or symbol comes to operate effectively in the place of a larger context of which it has once been a part. Meaning is just this effectiveness in the operation of cues or symbols. A thing has meaning when and in so far as what it leads us to do, or feel, or think depends on previous experiences we have had with it.

Obviously, therefore, meaningful material is only material that has *already been partly learned.* Even learning to spell, as we have seen, is influenced by the degree of meaning which the words have. We take this to mean chiefly that, because of the familiarity which meaning implies, some of the spelling has already been learned before the "spelling lesson" is assigned. Meaningful material is more easily learned than is nonsense; and if the same time is spent on the two, meaningful material will be *better learned* as the result of that effort.

Now it is also true that things that have been well-learned are less rapidly "forgotten" than things not so well established. One of the results of "over-learning," that is, of learning things better than is necessary to enable one at the time to do them effectively, shows this. As a result of over-learning the rate of forgetting is retarded; although the thing learned may appear to be no better done at the time, the ability to do it this well will last for a longer period of disuse.

The accompanying graph, from Gates, shows in a schematic way this effect of different amounts of learning on the rate of forgetting. Such a schematic curve is based on the results of numerous experiments in the literature of the experimental psychology of learning and forgetting.

The amount or degree of learning is represented by the rising curve, from no learning, to learning just sufficient to enable the learner to perform the act (threshold), and on to further practice (degrees of over-learning). The falling curves show the theoretical rate of decline or forgetting which follows each of these degrees of initial learning. Curve A resembles the curve of forgetting for non-sense material; Curve B that for the psychology lectures; Curve C that for very *meaningful narrative. Differences in the rate of forgetting,* we may therefore conclude, depend chiefly upon the degree of previous learning.

Results of this kind suggest at least a partial explanation of the *fact* of forgetting, as well as of its *rate.* Through learning, a cue, as part of a larger context, becomes an effective sign of or symbol for this context. If such a cue is continually experienced as a part of this context and of this only, it becomes a more and more effective sign for just this context.

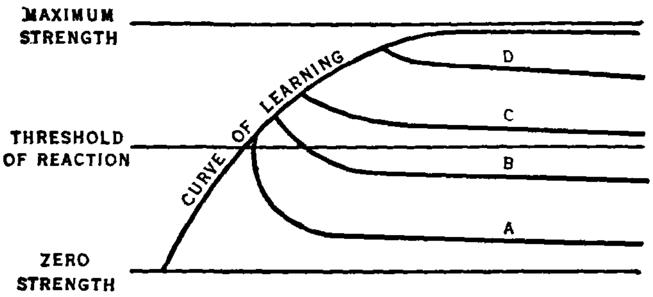

FIG. 31.—FORGETTING AS RELATED TO DEGREE OF LEARNING.

Curve A shows the loss or forgetting which occurs when the function is barely learned. The initial loss is rapid and great, followed by a much slower rate of deterioration. B, C and D show probable losses in functions which are over-learned slightly, considerably, and greatly, respectively. In all cases, after the rapid initial loss, the strength of the connections steadily but slowly decreases. (From A. I. Gates.)

Disuse, lapse of time, mean that such a detail is likely, instead, to be met as a part of *new contexts,* and as fast as this occurs the detail tends to become an effective cue for these new situations. It comes to lead to *different* responses than those to which it was originally trained. And unless special care be taken, such a detail will be encountered as a part of a *great number* of such new contexts. Just in so far as this takes place, it will tend to lose its effectiveness for any particular context, and especially for the original context for which it once functioned as an adequate symbol.

For the same reason the mere repetition of the cue alone, without occasional reënforcement by its significant context, may result in a loss. The infant who at first sees its mother frequently when it is to be fed, soon comes to react to the sight of the mother by feeding reactions. But if the mother now appear, as comes to be the case, in many other contexts as well, the infant soon ceases to make these specific feeding responses to that cue. It will now react in this way only when *other cues* for the feeding situation are also present. It may even look as though the infant had *forgotten* how to react to the appearance of the mother.

Mere repetition of a cue does not therefore enhance its effectiveness. It may and very likely will, on the other hand, reduce this effectiveness. It is repetition of the cue along with its significant context that adds to its power. We may say then that the loss in learning that comes through disuse or with the lapse of time is not due to any mysterious and special process to be known as forgetting. Such loss is for the most part at least to be explained as due simply to *more and different learning.*

PROBLEMS

1. What are the main differences between quantitative and qualitative studies of learning? Are similar distinctions found in other sciences?
2. Enumerate other specific quantitative questions or variables that might be investigated in an act of learning.
3. Find some specific quantitative study of learning in the periodical literature of psychology or education, and report it to the class, emphasizing (*a*) problem, (*b*) method and (*c*) results.
4. Write the alphabet backwards ten times, taking the time in seconds for each completion. Graph these times in the form of a learning curve and discuss the result.
5. Duplicate the experiment described in the text, with calcu-

lation, naming opposites and color naming. Average the results for several learners and graph the three curves. Compare them with those given in the text.

6. Describe some "plateau" experience in your own learning and try to discover the factors responsible for it.

7. Cite cases in your own behavior of limits probably set by (*a*) knowledge, (*b*) motivation, (*c*) physiology.

8. Adults can read a list of color names faster than they can do the color naming test, but children cannot. Why?

9. Evaluate the assertion: "You can't teach an old dog new tricks."

10. Collect the class records for the Substitution Test, done in connection with Chapter II, and study them as examples of individual differences in learning ability.

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CHAPTER IX

DETAILS OF MANAGEMENT IN INSTRUCTION

An experiment in the technique of impression. A teacher with an experimental attitude toward his work once tried to measure the effectiveness of different modes of emphasis sometimes used in his instruction.[1] His general method was that of presenting information to his classes by means of lectures. The students were expected to *learn* this material. By this we mean that they were to be able to make correct statements about the subject without the facts first being recited again in their presence. Reduced cues were to become effective—such cues as a question, the mention of a topic, or some element in a new situation, for which information of this kind would be useful in guiding thought or action.

Material was prepared containing 70 definite statements. After preliminary rehearsal so as to keep the general features constant, this material was presented to ten different audiences in the form of a lecture. Afterwards each person in each audience was examined to discover how much of the material he had learned. Various propositions were *emphasized* in different ways, and by ingenious arrangements it was provided that different propositions should be emphasized in any given way before each audience. This gave ten measures, using ten different statements of each method of emphasis, and made it possible to secure average results with a high degree of reliability.

The modes of emphasis experimented with are given in the following table, along with their relative values. In computing these values the score 100 was given to the average value of an unemphasized statement occurring in the middle of the discourse. All other values are stated in terms of this 100 as a base.

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[1] A. T. Jersild, "Modes of Emphasis in Public Speaking," *Journal of Applied Psychology,* December, 1928.

Mode of Emphasis	*Value*
5 repetitions, distributed at different points throughout the discourse	315
4 distributed repetitions of a statement	246
3 distributed repetitions of a statement	197
Verbal emphasis—"Now get this"—*prior* to making the statement	191
Primacy—first statement of the 70	175
2 distributed repetitions (statements 11 and 60)	167
Primacy—second statement of the discourse	163
2 distributed repetitions (statements 35 and 40)	162
Verbal emphasis—"Did you get that?"—after making the statement	154
Pause, before making the statement, for a time equal to that required to make the statement.	143
2 repetitions in immediate succession, toward the end of the discourse (statement 60)	139
Primacy—third statement of the 70	135
Recency—the last statement of the discourse	128
Loudness—the voice raised above the customary level	126
Recency—the average of two statements just before the last	121
Gesture—the arm raised in conventional gesture while making the statement	118
2 undistributed repetitions early in the discourse (at statement 10)	116
Banging fist on the table while the last word of the statement was being spoken	115
Ordinary run of statements, from positions 25 to 45, unemphasized and unrepeated	100
Slowness of speech—articulation retarded to half the normal rate of delivery	79

Various sorts of impressiveness. We may use the term impressiveness to describe the effect of any kind of emphasis or advantage contributed by one of these minor details in the engineering of learning. A technique that results in more or better or quicker learning than another may be said to be, in this sense, more impressive.

Of course the most impressive technique of all is for the learning to be planned or the teaching managed in the light of a clear analysis of what is to be learned, the cue that is to be made effective, and the context or motive to be used in its first production. Nothing is more impressive as an aid to learning than for the act to minister directly to an urgent and vigorous need or distress of the learner.

In addition to clear insight and a psychologically planned learning situation, various incidental aids may be employed, and many of these have been studied, both in rather artificial, laboratory experiments and also in connection with the bona fide learning of the schoolroom, the shop, the gymnasium. The results from Jersild's investigation will serve to suggest a number of these devices and to direct our attention to other studies that have been made along similar lines.

The effect of repetition. The repetition of an act of learning promotes that learning. This has often been called the law of exercise or the law of frequency. In the experiment just described a statement made but once was given a value of 100. Statements made oftener than this had always a higher memory value—were better learned. And, in a general way, the oftener the repetition, the greater the value. In the case of the simple experiments made on the learning of animals, repetition is the sole procedure in the hands of the trainer, unless changes are made in motivation and in the effectiveness with which the terminal act relieves the initial irritant, that is reward and punishment.

But more can be said about repetition than this. For one thing, we see from the table that repetition does not produce results commensurate with its "cost." Repetition shows a law of diminishing returns, at least in most cases of learning. Consider the results of different degrees of repetition, in the experiment just described. We here tabulate separately the comparative values for different numbers of "distributed" repetitions—that is, repetitions some distance apart.

Number of Times Presented	*Value*
5 times	315
4 times	246
3 times	197
2 times	162
1 time	100

Two exercises are better than one, but not twice as good; in fact it takes four repetitions to be twice as valuable as a single exercise, according to this table. This is the law of diminishing returns. In general such experiments have shown that for the more common forms of learning the value of repetitions increases with the number of repetitions, but more slowly—approximately as the square root of the repetitions. The explanation of this rather interesting result may be complex, but one factor that may be responsible for the law of diminishing returns is that the "easier" steps in cue reduction may be accomplished by the earlier trials. This leaves increasingly difficult steps to be accomplished by the later repetitions; they might therefore be considered to be just as effective as the earlier ones, since they have harder work to do. Their effects may be just as real though less spectacular.

A second important fact about repetition as an influence in learning appears when the "distributed" repetitions are compared with the "undistributed." In the table just given there are two cases of "2 undistributed repetitions," that is, repetitions in immediate succession. Their values, in different parts of the discourse, are 139 and 116. There are also two cases of "2 distributed repetitions," that is, repetitions of the same statement separated by a considerable interval. Their respective values are 167 and 162. Distributed repetitions appear to be more effective than undistributed.

Most effective distribution of practice. This result is confirmed by many similar studies[2] on such activities as learning syllables, mastering foreign vocabularies, code learning and substitution tests, addition and division, practice in multiplication, and the like. Thus in one study of code learning, four groups of learners practiced for the same amount of time, but the practice periods for the various groups were respectively 60 minutes, 45 minutes, 30 minutes and 15 minutes. The shorter the period, the greater the number of sittings, and hence the more distributed the practice. At the end of the same total amount of training all the groups were tested for their ability, with the following results. The 30-minute period was found the best:

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[2] See Daniel Starch, *Educational Psychology* (Macmillan Co., 1927), Ch. xi, for a convenient summary of many of these investigations, and for bibliography with reference to them

Period	*Gain*
15 minutes	22 per cent
30 minutes	36 per cent
45 minutes	25 per cent
60 minutes	15 per cent

In another case (Starch), also a study of code learning, "ten minutes twice a day was productive of the greatest progress, twenty minutes once a day was productive of almost as rapid progress, forty minutes once a day was productive of considerably less progress, while 120 minutes at one time produced scarcely half as much progress as the ten-minute or twenty-minute periods. The total time in all four distributions was the same." The results of this experiment are shown in the accompanying graph.

The most favorable distribution varies with the circumstances and must be determined experimentally if precision is desired. But, in general, massed repetitions are unfavorable. Very, very short periods, too much distributed, are also unfavorable; they waste too much time on each occasion in merely "getting under way." And periods that are too long, with some but not enough distribution, may be wasteful; monotony and fatigue may offset improvement.

A further general rule may be suggested, also on the basis of experiments in learning. This is that the most favorable distribution is likely to be not a mechanical one, mapped out according to uniform intervals. Instead, distributed repetitions early in the learning should come rather closer together; later on in the process they may be separated more and more.

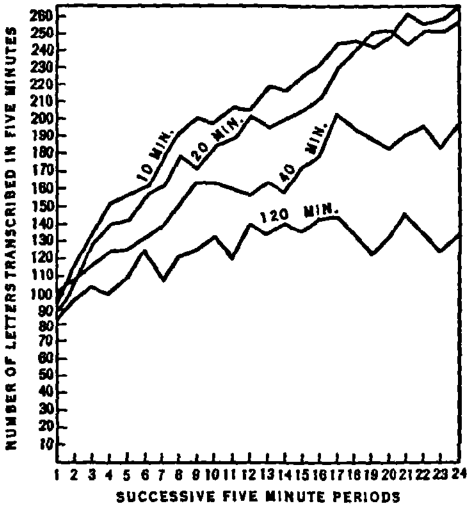

FIG. 32.—PRACTICE IN WRITING NUMBERS FOR LETTERS ACCORDING TO A KEY.
After Starch, *Educational Psychology,* Macmillan Co. Copyright, 1927.

Thus if ten repetitions are distributed in the two following ways:

1 2 3 4 5 6 7 8 9 10
1 2 3 4 5 6 7 8 9 10

the second arrangement would be found most effective.[3]

Attention-getting devices. Turning back again to the results in the table on page 190 we may consider some of the other techniques there measured. Several of these may be grouped under the head of "vividness." Verbal emphasis, before or after the statement, tends to "call attention" to the statement, giving it a clearness or vividness it might otherwise lack.

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[3] See for experimental evidence, L. H. Tsai, "The Relation of Retention to Distribution of Learning," *Journal of Experimental Psychology,* February, 1927.

Primacy, that is, occurrence early in the series, while attention is still alert and interest keen, has a similar effect.

These vividness devices give an appreciable advantage to the acts of learning to which they are attached. Some forms of vividness, however, are definitely better than others. The verbal emphases stand highest; they are more meaningful in character. The more mechanical the vividness devices employed, the lower, on the whole, they are likely to fall in the scale. Thus, raising the voice, making a gesture with the arm, and banging the fist on the table do have a certain emphasis; but their value is less than that achieved by verbal (meaningful) emphasis and by primacy in the series.

Some devices, used for the purpose of attracting attention, may even defeat their purpose. Slowness of speech in making a statement has a value in the table of only 79, as compared with a value of 100 for a wholly unemphasized statement. Such a device apparently does attract attention, but to itself rather than to anything useful in the learning situation. It is like some of the attention-getting devices used by the advertiser. They are so attention compelling that they take attention wholly away from the commodity, the name of the article or firm.

The basis of these attention-getting devices, when they are successful, may be seen in the simpler experiments with animal learning. When the cat is learning to get out of its cage by manipulating a latch on the door, anything that serves in the beginning to attract its attention to that side of the cage is likely to facilitate learning. The preliminary explorations are more likely to hit upon the latch than if the animal were busy elsewhere; the "examination is abbreviated" by the general orientation. For this reason, since the food box serves to orient the animal in its own direction, it is easier for the animal to learn how to escape if the gate or route lies directly between it and the food box than when it is necessary first to turn away from the "lure" and learn a "detour" before securing the food.

Direction of attention may be put to good uses in the guidance of learning, but, as the results have just shown, it may also be abused and be a positive handicap.

The direction of attention. Simple slogans like "Keep your eye on the ball" have an element of truth in them, but should not be followed blindly. The animal in the cage is better off in the beginning if it keeps its eye on the food box; its orientation is then in the right direction; extraneous stimuli are in part excluded through this limitation of scope to the general territory of the goal. But this is only in the simplest of cases. If a "detour" is required, and the solution does not lie directly in line with the goal, then the sooner the animal takes its eye off the food the better, so long as its motive persists and activity continues.

The same thing is true for the human pupil. The only flat rule that can be given is to direct the attention where it is most needed at the moment. This may be at one time the goal, the immediate stimulus to the act; at another time it may profitably be the act itself, as an aid to distinguishing between correct and wrong responses; at another time it may be the general result of the activity—the change produced in the environment, the effect of the act on the initial irritant.

What the teacher can do is mainly to modify the temporary "scope" of the learner; now to increase it by calling attention to relevant items that might otherwise escape attention; now to decrease it, so as to exclude items which, if they should become established cues might later lead to error or to interference.

In teaching performances in which the basic acts are already well accomplished, as in pulling a trigger, hitting a ball, it is usually a good rule to keep attention on the external stimulus —on the target or the goal. In activities where the movement itself is not already a fairly well-practiced one, as in swimming or in driving a motor car, it is not enough to keep attention fixed on the distant bank or "on the road." The actual goal is here a more immediate one, the particular instruments used, the arm and leg coördinations to be made. In cases in which the initial motivation is likely to be weak, as in perfecting penmanship, in spelling, or in drawing maps, attention may sometimes be usefully directed to some model to be imitated, or to some feature of the act that will as clearly as possible relate the act to the motive which it may at the time relieve.

As the act becomes perfected, attention can usefully shift to various elements in the context, which on subsequent occasions must be relied on to determine whether or not this particular act is called for. This is the stage of balance or control, at which stage cue reduction will have enabled the learner to perform the act itself almost "without attention."

Avoid the conflict of half-learned acts. If a given cue has been *established* so as to lead effectively to one response, which we may call *A*, the subsequent learning of this cue in connection with another act, *B*, is not found to interfere with the previous learning. Instead some experiments show that the later learning may even further improve the effectiveness of the cue as a stimulus to *A*. Once such a "connection" is well established, every time the cue occurs, it apparently *tends* to bring into being the responses previously associated with it, and this amounts to a certain practice.

But if the cue has *not* yet been well established for response *A*, then the attempt to train it for a different response *B* actually interferes with the previous learning. The two response tendencies appear in such a case to conflict. A practical application of this principle has been suggested in connection with the learning of new languages, in which at least some part of the learning consists in establishing a foreign word as the response (equivalent) to a word in the native language. If two foreign languages are undertaken in this way at the same time, or before either is very well mastered, interference may be expected, and the procedure would be inadvisable. But if one language has already been well learned first, not only may the second then be learned more easily but its learning may even work favorably upon the mastery of the first.

The advantages of attempted recitation. In an interesting experiment on recitation attempted before complete mastery, Gates [4] showed the value of this procedure in a very clear fashion. Pupils were set to "learn by heart" two kinds of material, non-sense syllables and meaningful prose. In some cases all the time was devoted to studying (reading) the material without any attempt to recite it until the end of the study period. In other cases varying amounts of the time were spent in attempting to recite at a signal, prompting oneself by glancing at the material when necessary. The following table gives the results.

Material and Method	16 Non-sense Syllables Per Cent Remembered		Meaningful Material Per Cent Remembered	
	Immediately	After 4 Hrs.	Immediately	After 4 Hrs.
All time devoted to reading ..	35	15	35	16
20 per cent of time devoted to recitation	50	26	37	19
40 per cent of time devoted to recitation	54	28	41	25
60 per cent of time devoted to recitation	57	37	42	26
80 per cent of time devoted to recitation	74	48	42	26

This table of results shows:

1. The greater the amount of time devoted to attempted recitation, the greater the percentage of the material recalled. This is true for both kinds of material.

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[4] A. I. Gates, "Recitation as a Factor in Memorizing," *Archives of Psychology,* No 40, 1917.

2. The influence of attempted recitation is much greater in the case of non-sense material than in the case of meaningful prose.

3. The advantage of the method of attempted recitation is much greater in the case of delayed memory, memory after four hours, than in the case of memory immediately after having completed the study period.

Several explanations for this important result or set of results may be suggested, and all of them have a direct bearing on the technique of directing learning. Some of these explanations are as follows:

(*a*) The learner is ultimately going to be called on to *recite*. Therefore this, not reading, is what he should learn to do.

(*b*) In attempted recitation just those cues are going to be introduced that are later to be depended on.

(*c*) The awareness of success or failure in the method of attempted recitation builds up a stronger motive for the act of learning, for the chagrin of failure is added to whatever other demands may have set the process going in the beginning.

(*d*) The learner by the recitation method is able to discover where the difficult portions of the task are and to distribute his attention and effort accordingly.

Global versus piecemeal learning. It is often said that it is better, in learning a new act or in mastering a given amount of new material, to study it as a "whole" rather than by taking it bit by bit. The "whole" or "global" method is said to be superior to the "part" or "piecemeal method." This has often been found to be the case in experimental investigations, which have usually dealt with the memorizing of verbal series.

Thus in one case poems about eight pages long were learned both by reading the whole poem through three times a day until it could be recited (whole method), and also by learning a verse a day, then reviewing the whole to perfect recitation (part method). The part method was found to require nearly 25 per cent more study time than the whole method.

The following table, giving some of the results of such experiments (Pyle and Snyder), leads to similar conclusions.

Number of Lines	Part Method, Time Required		Whole Method, Time Required		Percentage of Time Saved by Whole Method
20	16 min.	12 sec.	14 min.	17 sec.	12
30	27	23	23	53	13
40	38	44	35	16	9
50	48	31	43	53	12
60	81	10	63	38	22
120	168	55	139	55	17
240	431	20	348	00	19

On the other hand, certain other investigations of the two methods in non-verbal performances, such as learning to trace a complex maze with a pencil (Peckstein) found the advantage to lie with the sectional method.

Several considerations may be pointed out. In the first place most learners, if left to themselves, would perhaps adopt the sectional or piecemeal method and have established this as their usual procedure in learning. To adopt the whole method suddenly goes counter to their learning habits, and this method might at first be found inferior, although with equal practice it might work better.

The advantage usually credited to the whole method is that by it the learner practices precisely what he hopes to do at the end of training; all his cues come to lead in the right direction. In the part method the repetition of sections means forming the habit of going back to the beginning of one section after completing it, rather than on to the next, and this is not only useless learning but is often a positive hindrance.

On the other hand there are processes, such as swimming, in which it is not feasible to learn bit by bit. One must even in the beginning do the thing as a whole, at least to the point of being able to keep afloat. The only other method would require "formal exercises," in which various parts of the process were rehearsed separately, which would not be swimming.

Apparently the most that can be said is that each act of learning may well be studied in its own right in this respect. It may be that for some materials one method is best, for other materials another. The part method in general has at least the advantage that it is more likely to give the learner some sense of progress. Moreover many projects, such as calculus, *must* be mastered bit by bit, since later parts presuppose the adequate mastery of earlier parts. Often some judicious combination of the two methods is likely to be advisable.

Knowledge of results. Imagine an apprentice in archery learning to hit a target placed so far away that he cannot hear the landing of his arrow. Suppose further that he is required always to practice in the dark, so that no visual clues are available, informing him of his success or failure, and that by all other possible means he is prevented from knowing the outcome of his endeavors. In no way would his acts be able to relieve the irritant that led to them—say the mild chagrin of not being apt with bow and arrow. Naturally enough we should not expect any improvement as the result of practice—there would be no learning. His arm to be sure, might become stronger, but this would not be learning, it would be *growth.* If he should become better able to place the arrow in the bow and to discharge it effectively, this would be due to a violation of the conditions; it would be because he actually had some clues, through the sense of touch, of the result of his activity.

Knowledge of results, therefore, that is, some actual experienced effect of the activity upon the irritant that leads to it, is required for all learning. It is hard to believe that any one ever seriously supposed this not to be the case. Yet a number of investigations have been reported which sought to discover whether or not knowledge of results makes a difference in the progress of learning.

We may understand the issue perhaps by making the distinction not between knowledge and complete ignorance, but between various degrees of knowledge. The question then becomes, does additional and more specific knowledge of results influence the course of learning? The following experiment will illustrate the general nature of these studies. The subjects of the experiment were required to write the letter *a* legibly as many times as possible in a fixed time—30 seconds. The experiment was continued for 15 successive sittings, and the subjects divided into two groups.

The "informed" group were shown their scores from time to time, and thus made aware of the progress of their skill in this act. The "ignorant" group were not provided with this special exhibition of the results of their work. At the end of the tenth sitting the groups were reversed. Those who had up to this time been informed were no longer given this special information; those who had been ignorant were now given the results. The preceding graph shows the rates of progress in the various cases.

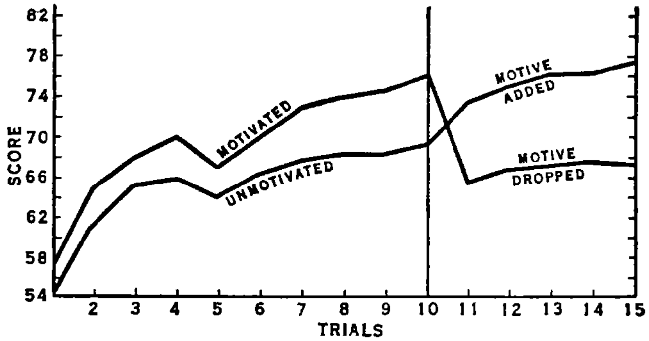

Fig. 33.—Showing the Effect of Exhibition of Scores on the Rate of Learning. Such Information and Publication of Results Provides Additional Motive. (From Book and Norvell, adapted.)

From the beginning the informed group improve at a more rapid pace. When information was withdrawn, at the tenth trial, this group slumped remarkably; not only did they cease to improve, but the whole level of their performance was inferior. The previously uninformed group, however, now given knowledge of their results, not only continued to gain, but forged ahead with a remarkable spurt.

We must examine these results rather carefully. Note in the first place that even the uninformed group of learners actually made notable progress from the beginning. This must mean that they were not actually wholly ignorant of the results of their work. To be sure they lacked the special exhibition of their scores, planned by the experimenter; but from seeing their work proceed and noting the changes in their own movements and feelings, they actually received considerable information. They differed from the informed group only in having somewhat *less exact* knowledge of results.

Moreover, the remarkable lapse in the case of the previously informed group, when information was kept from them, suggests that something more than knowledge was involved. The slump and the decline in rate of progress can only mean that the initial motive had been weakened. In this case the exhibition of the scores is more than an added bit of knowledge; it results in an actual intensification of the motive, and it is this change in motive which appears to have been the chief factor at work.

We may nevertheless make the most of the fact that progress in learning *is* dependent on knowledge of results, and it follows from this that the more complete, specific, and immediate the knowledge, the better will the learning proceed. This is why deferred relief, postponed information, is less valuable as an aid to learning than that which is closely tied up with the act itself.

It should be pointed out that the investigators[5] responsible for the experiments we have just reviewed clearly realized that it was motivation, not mere information, that was being studied. The investigation is described very accurately in its title as one dealing with "the will to learn."

Providing effective motives. Knowledge of results, as we have just seen, may affect the rate of learning if only by modifying the learner's "self-esteem." Teachers well know that social approval or disapproval at the hands of others also definitely affects the learning of adults, as well as of children. A single experimental demonstration of this fact may be cited. Hurlock[6] measured the ability in working problems in arithmetic in the case of a large number of school children. These were then divided into groups of equal initial ability; all the groups were given several days of practice and record was made of their respective rates of improvement, under different modes of "treatment."

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[5] Book and Norvell, "The Will to Learn," *Pedagogical Seminary*, December, 1922.

One group was strongly praised for the excellence of their work; another group was scolded for their inferiority and carelessness; a third group was allowed simply to listen to the approval or disapproval of these groups; a fourth group, the "control," neither received nor heard any comments. All the groups are then called upon for the successive practice periods of work in arithmetic.

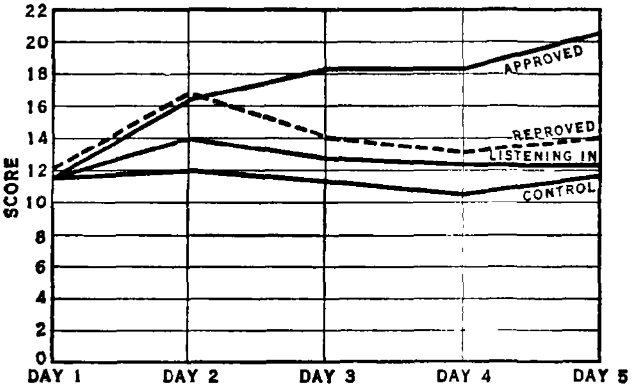

Fig. 34.—The Influence of Approval, Disapproval and "Listening In" on the Approval or Disapproval of Others. (After Hurlock.)

The accompanying graph shows the outcomes, in the case of these variously motivated groups, all of whom were at the beginning of equal ability in the thing practiced. The "control" group makes no gain; the "listening in" group improve slightly at the very next performance, but the effect does not last. The "reproved" group make a notable gain at the next performance, but, receiving no further discouragement, the effect also wore off, although this group continued to do better work than either the "control" or the "listening in" group. The "approved" group, although receiving no further comments, continued to forge ahead steadily and nearly doubled their score by the end of the practice periods. All the other groups finished little better than they had been in the beginning.

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[6] E. B. Hurlock, "The Value of Praise and Reproof as Incentives for Children," *Archives of Psychology,* No. 71, 1924; also "An Evaluation of Certain Incentives Used in School Work," *Journal of Educational Psychology,* 1925.

We cannot hastily generalize from such results, of course. Over a longer period of time disparagement might result in increased effort; soft praise, especially if unjustified, might lose its potency; some more fundamental motive might seize upon the control group and act in ways much more effective than verbal comments of the teacher.

Individual differences are also important. A distressing sense of inferiority, however induced, may arouse one pupil to more vigorous attack; it may lead another to abandon the quest for excellence in this activity and turn to others the outcome of which is more consoling; in another any kind of "induced" excitement may simply fluster and interfere with calm progress. Such individual differences in motivation are so important that the teacher should be alert to them; they are in some ways as important as are differences in native capacity for cue reduction.

Various other studies of the effect of approval and disapproval, encouragement and discouragement, on learning and on mental work have been made. Gilchrist[7] found that a group of workers who had been praised for their achievement did 79 per cent better work in a second test, whereas a group that had been discouraged by disparaging remarks did 6 per cent poorer work instead.

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[7] E. P. Gilchrist, "The Extent to Which Praise and Reproof Affect a Pupil's Work," *School and Society*, December 2, 1916.

Gates and Rissland[8] experimented with three groups of college students; one group was praised, another reproved, and a third received no comments. When the three groups subsequently repeated the tests there was found "a very slight difference in average improvement or even in percentage of individuals who improve in three groups. . . . Such difference as there is seems to be in favor of encouragement or discouragement rather than mere repetition." The suggestion would be "that it is better to make some comment about the score than to make none; that it is a little better to make an encouraging than a discouraging remark; that relatively poor individuals are more likely to be unfavorably affected by discouragement than are relatively proficient individuals; that the effect of these incentives does not seem to be constant for the (various) tests."

The avenue of stimulation. As a final illustration of details in the management of instruction we may consider the way in which the materials or the problem may be presented to the learner, especially the sensory avenue of presentation. Any problem in learning, such as that of mastering a stroke in swimming, may often be presented in various ways. Thus, in teaching swimming, the problem may be presented by placing the learner in the water; by talking to him, verbally describing the movements to be acquired; by letting him observe the movements of other swimmers, or motion picture films, lantern slides, drawings, diagrams, written or printed instructions, or even charts of figures or mathematical formulae. In the case of "subject matter" presented in the classroom or auditorium, many of these options are available. Touch, hearing and sight are all available; and in the case of vision there are many alternative ways of presenting material. Does it make any difference which avenue of presentation is used?

So far as the various senses are concerned, no one method of sensing seems to have an advantage. If the stimuli are equally clear, we learn equally well to react to cues from any sensory field. Differences in sensory keenness, among individuals and differences in past habits, will of course count, but on such individual variations no important generalizations can be made.

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[8] G. S. Gates and L. Q. Rissland, "The Effect of Encouragement and of Discouragement upon Performance," *Journal of Educational Psychology*, January, 1923.

Investigator	Best Method	Second Best	Poorest Method
Kirkpatrick .	Objects seen and words heard	Words seen only	Words heard only
Pohlmann ..	Objects seen only or with words heard	Words heard, or seen and heard	Words seen only
Moore	Objects or pictures seen	Words seen only	Words heard only
Erickson and King	Lesson heard only	. ....	Lesson read (seen)
Sumstine .	Motion pictures seen only	Film seen and lecture heard	Lecture heard only
Lacy	Story heard only	Story read (seen)	Film seen only
Weber (1) ..	Film seen and story heard	Film seen only	Story heard only
Worcester .	Materials heard	. .. ..	Materials seen
Weber (2) ..	No considerable differences between film alone, story heard, film seen and story heard, or story read silently (except for ability to draw objects, in which the visual methods were superior)		

Experiment shows, however, that the use of *several* avenues of presentation is often superior to that of any single one. Such a method also provides the most favorable way of meeting the difficulties that depend on individual differences of habit or of sensory keenness. Swimming instruction that is conducted by *various* means, that uses the senses of touch, of sound and also of sight, is likely to be more effective than that confined to one sort of material. In other words, the more the cues that are available, and the greater the variety of these cues, at least within reasonable limits, the more likely is cue reduction to proceed effectively. The results of some of the great number of experiments on the relative merits, under different circumstances, of different avenues of impression, may be summarized in the preceding table.

These studies, and many more like them, illustrate the numerous available ways of presenting materials to a group of learners. They suggest that the value of the variou methods may depend on the nature of the material, the purpose of the presentation, the character of the observers (as ol or young), the method of measuring the results, the amoun of interest aroused, and perhaps other features.

The different investigations are as a matter of fact fa from comparable. Some of them employed disconnecte words while others used meaningful material, such as pros passages. Nor can we compare words seen for two second with words spoken at the rate of one for each two-secon period. Obviously the comparison of seen words with hear words is very different from the comparison of seen picture of objects with the heard names of them. But for no on type of comparison is there adequate evidence of univers advantage or disadvantage. In addition to these complica tions, results from children are not comparable with thos from adults. Detailed circumstances of each set of materia and conditions of experience introduce further complication

The most that can be said in general is that the teach can best consider the nature of the materials; such factors relative time, effort and expense; the purpose of the present tion; the previous habits of the pupils; the relative intere and novelty of the various methods; their mechanical adva tages; and particularly the desirability of providing a varie of cues, any one of which, when available in later life, m serve to put the learned act, thought or feeling at the dispos of the pupil.

Concrete materials versus symbols. Although no one avenue of sensory presentation seems to have a distinct advantage, something definite can be said as to the relative merits of concrete versus symbolic ways of presenting information and instructions. Human beings are more alike in their sensory than in their perceptual capacities. That is, they are more alike in their mere ability to hear sounds and see objects than in their ability to treat these sights and sounds as symbols and comprehend their meanings. The greater the symbolism entering into the materials presented, the more will members of the audience differ in their comprehension of it. And the more subtle the symbolism, the greater the differences will be.

The simplest symbols are likely to be based on *similarity.* This is the case, for example, with pictures and with gestures. More symbolic than pictures would be such things as graphs, maps, diagrams, blue prints. Here the resemblance or similarity is reduced to a bare detail. The lines of the blueprint may represent bricks, but they do not *portray* bricks. They are similar to rows of bricks only in their directions and spatial relations.

In the case of words the symbolism is still more remote from similarity. And the more technical the vocabulary the more subtle the symbolism, the more arbitrary and unfamiliar the meanings. We could thus arrange various ways of telling a story or presenting material for study in a hierarchy of symbolism, with concrete objects at one end and subtle symbols such as statistical coefficients at the other. The series would be somewhat as follows:

1. Seeing the actual events take place or handling concrete objects and materials
2. Seeing the events "acted out," as in drama or pantomime, by people who "represent" the actual characters of situations
3. Motion picture portrayal of the events, or of actions intended to represent them
4. Photographs, still pictures of significant characters and objects

5. Maps, diagrams, blueprints and similar graphic representations of objects, facts and relations
6. Verbal account and description, heard or read, in the mother tongue, using the vocabulary of daily life
7. Description through the use of technical symbols and terminology, indices, coefficients, foreign speech or similar sets of special and recondite signs

The earlier in this series a method stands the more nearly alike will people be in their ability to understand it, and the more equally will they be informed by its use. The later in the series the method stands, the greater the heterogeneity of mankind, and the more diverse the degrees of understanding will be.

If the group to whom material is presented is very heterogeneous, the simpler methods will be the more likely to carry the message to all. The younger, the less sophisticated and less educated the audience, also, the more likely will the simpler methods be to promote equal and general understanding.

If uniformity of comprehension is desired, the simpler the method the better. Often diversity of reaction and opinion is wanted instead; in such a case more symbolic presentation may serve to provoke individual differences that might otherwise go unannounced.

PROBLEMS

1. Present to the class a series of car card advertisements, exposing each for about two seconds. Then have each student recall as many as he can, identifying them by a brief written description. Find the number of times each card is recalled and try to explain the differences.

2. Read a list of words, with the instruction to recall them at the end of the reading. Repeat some words two, three or four times, at different points in the series. From the memory scores compute the values of different frequencies of repetition. Do primacy and recency in the series have any influence?

3. If an advertiser expected to send a series of six form letters

to prospective customers during the first six months of the year, what mailing schedule would you recommend?

4. Show the equivalent of attempted recitation in learning to drive a motor car.

5. Memorize one half of a poem by the piecemeal method and the other by the global method. What results, and what explanation, if the results differ from those given in the text?

6. What motivations did the old "spelling bee" introduce into the study of spelling?

7. Show how the purpose of the presentation might determine the relative value of different methods of exhibiting the materials of instruction, as in a lecture.

8. In what ways does "knowledge of results" operate to improve the process of learning?

9. How might a teacher of elementary arithmetic use practice curves to stimulate learning how to multiply fractions?

10. Do you consider the public posting of grades in term examinations to be a psychologically approved way of using knowledge of results?

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CHAPTER X

THE PSYCHOLOGY OF CLASSROOM METHODS

Classical procedures. A number of general methods of instruction have been so much discussed or so widely used that they may be called "classical." Under each method, special adaptations will be made to the subject matter, the pupils, and the purposes of instruction. But the general features remain recognizable above these modifications. The student of education will wish to be familiar with some of these classical procedures, and with their psychological implications.

The general methods to be considered in this chapter will be as follows:

(*a*) The method of apprenticeship
(*b*) The method of drill or rehearsal
(*c*) The inductive or "logical analysis" method
(*d*) The purposive problem or "psychological analysis" method
(*e*) The project method

The general questions to be raised will be, in each case—"What are the special characteristics of the method?"; "What are the special advantages and disadvantages of the method?"; and "What can be said of the psychological soundness of the method?"

The method of apprenticeship. This is one of the oldest of pedagogical methods. The learner definitely "learns by doing." He watches a skilled workman, or other performer, assists in the simpler tasks, meanwhile observing the more difficult acts and trying in time to master them also. The method is still much used in industrial and professional education. The plumber's or carpenter's apprentice has a recognized trade status and passes from this to other definite levels of recognized trade skill.

In engineering education a similar method is suggested by the "study-work" arrangements. In these plans the student spends certain periods of time in the classroom and laboratory, and certain periods in the industrial plant. Medical students and clinical psychologists are often required to spend certain periods of time as "internes" as part of their professional training. In the training of teachers "practice teaching" is a recognized device. The learner, under the guidance and advice of more expert teachers, tries out in practice the principles learned in the classroom, and becomes acquainted at first hand with some of the problems and difficulties.

The method of apprenticeship, in its modern form, has many distinct advantages and may be based on sound psychological principles. Among the various advantages and disadvantages may be noted the following:

ADVANTAGES

1. *The curriculum is directly provided,* by the practical nature of the work engaged in. This is just such work as that for which the learner is to be prepared. Irrelevant material is not likely to be included in the activities, and the problems of "transfer" arise only as they do in life, as distinguished from school.

2. *All learning is by doing* rather than by "talking about"; one effect of this concreteness may be greater interest; in the case of relatively poor learners, better understanding of the topics is promoted; trial and error correction is at once provided, not artificially, but through the immediate knowledge of success or failure.

3. *The tests are direct, objective, impersonal.* The examinations or checks on the progress of the pupil are not set by a teacher. They are administered by practical life itself. They are therefore likely to be always relevant, and fair and in themselves of educational value.

4. *Provision for individual differences is automatic.* It is in fact unavoidable by this method, for each apprentice will necessarily learn only according to his own rate and zeal, and progress will largely depend on his own ability.

5. *All learning is clearly purposive, intrinsically motivated.* The activity is closely tied up with the "life career motive" and thus takes advantage of one of the strongest of the learner's "drives."

DISADVANTAGES

1. There is an ever-present danger that the apprentice may become only a "helper" or "slave" of the workman, and that his status as learner may be forgotten and neglected.

2. The study of industrial management has shown that the best workman is not necessarily the best teacher, and does not necessarily even understand the principles on which his own skill depends, and perhaps cannot communicate them to others.

3. Background subjects, cultural topics, tend to be ignored and training tends to be narrow and limited in scope.

4. Non-vocational teaching, covering many important character traits and civic ideas, is not provided for.

5. Preparation for promotion may not be provided. For promotion often consists in being set to do something *different*—directing other men rather than managing machines, for example.

The life-career motive. The effectiveness of tying the learning activities closely to the vocational plans of the learner has been much discussed in educational circles, but little available *evidence* has ever been produced on the topic. We find a college dean reporting that:

> It is inevitable that a boy will lie down on his job [as a college student] if he can see no connection between what he is asked to do and what he hopes to do or think in later life. . . . The result of not finding any motive sufficiently dominating to float a boy past all kinds of secondary interests is for the most part responsible for the reputation that our colleges have for ineffective work.[1]

Since the effectiveness of the method of apprenticeship is so often supposed to be due in part to the way it relates learning to the life-career motive, it would be instructive if more studies of an experimental kind were available on this topic. Few are to be found reported. The following example [2] will serve to suggest the type of inquiry that might profitably be made in various educational situations.

Of 160 boys in a high school, it was found that 82 had indicated vocational choices, and considered their school work to be by way of fitting them for their life work. The remaining 78 had not yet made any vocational choice. An attempt was made to discover whether differences of any important kind were present between these two groups, and whether the professed "life-career" interest made any difference in their high school work.

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[1] Report of the Dean of Columbia College, 1927, p. 16.

[2] G. N. Kefauver, "The Life Career Motive and High School Work," *School Review*, June, 1926, pp. 426–431.

Intelligence tests were given; quality of school work was rated on a numerical basis; and ratings for "application" were made by the teachers. When boys of the same mental age were grouped, those with the life-career motive did not differ, in quality of school work, from those without it. Nor was any reliable difference found in the trait of "application"; those without decisions looking forward vocationally applied themselves to their work as effectively as did those with the professed life-career motive. No difference in intelligence was found between the two groups.

In this case at any rate the life-career motive appeared to have no influence upon the quality of the work and no effect upon the pupils' devotion to that work. No generalizations can of course be made from a single study, with so few cases, and by such restricted methods. But this investigation will serve as an example of a type of psychological inquiry which the discussion of the apprenticeship method makes desirable.

The classroom drill. The traditional method of classroom drill is illustrated by the usual way of learning a poem, parts for a play, the drill exercises of military training; the recitations of spelling lists; learning the steps in dancing; copying exercises in penmanship and typing and finger exercises at the piano.

Drill resembles apprenticeship in that the things supposed to be actually needed are acquired by their *exercise* and *repetition.* The emphasis throughout is not upon the relation of the act to any immediate urge of the learner, but reliance is placed in the main on the effectiveness of *frequency* as an instrument of cue reduction.

Drill differs from apprenticeship in that the thing learned is acquired and practiced *out of its context,* as a more or less isolated and separate skill. Its relevance to life, outside the drill situation, is often far from clear to the learner, and may be only vaguely understood even by the teacher.

Drill is likely to be a useful method in acquiring purely *muscular* dexterities (including verbal tricks), which can easily be broken up into their elements, these rehearsed, and then combined or applied in new contexts. Thus in learning the keyboard of the typewriter, the separate letters can be located by drill, and then combined in the writing of words. The drill exercises themselves may, however, consist of mere nonsense combinations of letters. Many simple industrial operations are of this sort. Driving a motor car, on the other hand, represents similar activities that cannot so easily be broken up into their separate elements, and for which apprenticeship rather than drill appears to be preferable, or perhaps some combination of the two methods.

ADVANTAGES OF DRILL

1. The method of drill or rehearsal is calculated to secure with certainty the *minimum standard* of proficiency in all learners. It is thus a guarantee of minimal achievements being reached and is useful when the behavior of groups, rather than provision for individuals, is important. The drill formations of soldiers illustrate this advantage.

2. Drill tends to render performance automatic and certain, eliminating decisions of choice. Thus the *best practice* or the *approved technique* may be instilled in all. This is an advantage in certain simple forms of work. Thus in typing it is desirable to use always a *certain* finger for a given key. Reducing this habit to automatism through rehearsal or drill frees attention for other decisions and adaptations.

3. Drill does not usually require expert teachers nor profound pedagogy. The drill technique may itself be drilled into the instructor, who may follow the effective principles, even without understanding them. When only poor teachers are available, and when the curriculum has been wisely chosen by others, drill, with its automatic outcome, has some advantages.

4. Drill, if properly planned and organized, reduces fumbling, eliminates the learning of irrelevant material, and focalizes effort on the relevant items. It thus avoids ambiguity, obscurity, and useless learning, or may do so.

Disadvantages

1. Drilling is synonymous with boring; one may either *drill* a well or *bore* it; one of the greatest defects of drill as a method is its boring character. It readily becomes deadly and monotonous and to this extent fails to enlist the vigorous effort of the learner.
2. Drill may often involve over-learning of an excessive degree. Unless great care is taken, all parts of the lesson are mastered equally well, although they may very well be actually of different degrees of importance. Useless bits of material learned by the method of drill still stick in the mind of every adult schooled by old methods—lists of products, dates and rules, sequence of generals in a war.
3. Because of the mechanical basis of drill, it tends to be destructive of initiative; facts learned are often not closely related to reality, and may not even be understood.
4. Unless care is taken, the method of drill is likely not to be nicely adapted to individual differences, nor to provide individual rates of progress. There is a temptation to drill a group, and all of its members until the poorest learner has reached the minimal level of proficiency. But this means marking time or gross over-learning on the part of the rest. On the whole drill as a method seems best suited chiefly to muscular activities and to relatively dull students.

Some of the disadvantages of drill may be reduced, and other sorts of usefulness secured, by a number of devices. Motive not initially there may be *introduced,* by rivalry, contests, or competition with one's own record. Introduction of rhythm, as in movement and in singing, gives new zest to a drill, when it is feasible. As a juvenile "country school teacher" the author once tried to teach the ABC's to an old fashioned "chart class" of foreign speaking children. Little success was met until the happy thought of introducing rhythm and rhyme occurred. The letters were set to the tune of "Yankee Doodle" and promptly repeated with gusto.

Making sure that the *right act* is practiced from the start is important in drill. Practice makes perfect, but it perfects the errors as well as the successes. Errors once "drilled in" may require much reëducation before they are eliminated.

Finally, distributing drill exercises according to the schedule which experiment shows to be most effective, makes a useful improvement. As we have already seen, distributed repetitions are often superior to massed exercises; frequent short drills are in general better than a smaller number of long ones; exercises repeated close together in the earlier stages, and gradually separated farther and farther, are also more effective than those distributed mechanically according to the clock or the calendar.

Flash cards as instruments of drill. An example of many of the characteristics of drill as a classroom method is to be found in the use of flash cards. Cards may have printed on them number combinations, fractions, words, or brief directions, and the like. The cards are quickly and briefly exposed, and some action or reply is to be made on the basis of the material or instructions presented on them.

Flash card exercises may be organized as games; competition may be introduced between sections of the class; individual scores may be kept. The arguments advanced in favor of the flash card technique are several: it stimulates interest; it encourages prompt action; it favors observation that is exact and accurate; it emphasizes the meaning of what is presented, rather than its mechanical articulation (as in reading); and so on.[3]

An instructive experiment on the effect of flash card drill in the teaching of reading will serve to exhibit also some of the general results of drill as a method.[4] Two groups of elementary school pupils were formed which, on the basis of preliminary examination with a variety of reading tests, were of equal ability. One group then received special periods of training with the use of flash cards; the other group spent the equivalent time in silent reading. In all other respects, such as work in other aspects of reading, and in spelling, writing, and various activities, the two groups were treated alike.

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[3] See S. C. Parker, *Types of Elementary Teaching and Learning* (Ginn & Co., 1923), for interesting accounts of some of the useful applications of flash cards in drill.

[4] A. I. Gates, "Functions of Flash-Card Exercises in Reading," *Teachers College Record*. December, 1925.

At the end of the periods of such training (four to six weeks with various sub-groups) all the pupils were again tested for various sorts of reading ability, in order to see whether those who had received the intensive flash card drills differed from those who had not. The results were definite:

1. In ability to read flash cards, the drilled group was now superior to the group with no flash card training. Drill in the specific act had improved ability in that specific act.
2. In reading for speed and accuracy under ordinary conditions (with the usual printed matter and exposure methods) the two groups were quite alike. Training in the specific flash card activity had not "carried over" to these different contexts in such a way as to make demonstrably different efficiency.
3. In tests of oral and silent reading which "involved measures of speed, accuracy and depth of comprehension," the flash card drilled group was inferior to those who had spent the equivalent time in silent reading. That is, each group now excelled in that particular thing in which each had received the greater amount of specific training.

The results emphasize the general principle that in the method of drill particular pains must be taken to consider beforehand just what operations it is desired to improve, and to see to it that these specific acts are developed, and trained to just such cues as are to be available when the acts are required.

The inductive or "logical analysis" method. At one time the favorite basis for "methods of teaching" was that based on the doctrine of "apperception." This term, taken from the psychology of Herbart, was supposed to sum up the essentials of the laws of thinking and learning. The mind, according to Herbart, was composed of "ideas," and these ideas were related in various ways. Some ideas were consistent with one another; others were "opposed to" one another; still others were simply "strangers."

"Apperception" represented the way in which ideas already present or "known" welcomed and received "new" or "unknown" ideas. The existing background of "information" was the basis for the reception and understanding of new facts. The situation as pictured was much like that of immigrants arriving in a new country; they would be better received and would more easily "find a place" in the new land if they had *relatives* there, ready to welcome them.

The work of the teacher was that of engineering the materials and the activity of the learning period in such a way as to conform to these logical "laws of thought." The process became quite formalized, and the act of teaching divided into several "formal steps," which, in the proper sequence, constituted the method of the "inductive lesson." These "steps" were worked out with great care and applied to a variety of materials. The training of the teacher at that time consisted largely of variations and illustrations of these "five formal steps." They were as follows:

THE "FIVE FORMAL STEPS"

1. *Preparation.* This was the process of paving the way for "apperception" and assimilation by arousing to activity the knowledge or ideas already acquired; by stating the question or problem of the lesson shortly to come, and showing its aim in the light of knowledge already acquired.
2. *Presentation.* This step consisted in the bringing forward of the particular facts, objects, or new materials to be mastered in the new lesson.
3. *Comparison.* In this step the new facts were analyzed, classified, related to one another and to the "old" materials of knowledge. They were grouped under familiar categories, the relevant and irrelevant items were distinguished, and the most significant abstracted from the total mass of new material.
4. *Generalization.* Principles and laws were sought at this point; formulations, that might be carried over to new situations. Conclusions were reached which might best sum up the facts presented

and compared in the preceding step. Rules were stated and related to rules already known.

5. *Application.* In this final step the bearings of the new facts were considered; the principles were applied to practical problems and new situations. Especially, by this process, the new information was "tested," and an effort was made to ascertain whether the lesson had actually been effectively learned.

These steps most closely resemble the methods used in laboratory instruction, for the report of the outcome of the experiments conducted by the student. A common policy followed in such work is to prescribe the following "steps" for the final report:

(*a*) State the purpose and aim of the experiment.
(*b*) Describe exactly what was done and exhibit the precise data without interpretation.
(*c*) Analyze these data, combine, classify, correlate, compute relationships.
(*d*) Draw conclusions on the basis of these comparisons, and show how these conclusions bear on the problem.
(*e*) Show the practical significance of the results, their bearing or meaning in daily life, in industry, education, and other fields.

An illustration of the Herbartian method. We may illustrate the method here considered by supposing that a college teacher of psychology wishes to present to the class for the first time the facts usually referred to as "Weber's Law" or "the psychophysical law." The general fact is that in sensation and perception the *conscious effect* of stimulation does not increase in proportion to the increase of *stimulation.* Increases in the intensity of an experience (as the loudness of a sound) which are all "just perceptible" and in this sense might be said to be "equal" (since equally perceptible), require larger and larger increments of stimulus as the magnitudes compared become greater.[5] The teacher might be expected to proceed in something like the following way, following closely the "formal steps."

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[5] Readers unfamiliar with these general facts will find them described in detail in the usual textbooks of general psychology or experimental psychology.

1. *Preparation.* Suggest various psychological laws already discussed. Show for example how the *quality* of a sound depends on the *form* and *rate* of the vibrations causing it, and raise the question whether there are also *quantitative* laws of the relation of sensation to stimulus.
2. *Presentation.* Demonstrate experimentally such facts as that:
   - (*a*) Some stimulus changes (small ones) may go quite unperceived. A certain magnitude of stimulus change is required if it is to be perceptible.
   - (*b*) The perceived change comes more easily if the magnitude with which the new stimulus is compared is small.
   - (*c*) In each sense (sight, sound) a rather definite *fraction* must be added to whatever stimulus is already present if a *change* is to be perceived.
3. *Comparison.* Bring together all these observations, from the fields of the different senses, show how the fractional "constants" vary with the sensory field, and suggest some general formula, such as the "logarithmic law."
4. *Generalization.* This step grows naturally out of the preceding one, but other "logarithmic" relations may now be introduced, such as "diminishing return" in industry, in the effect of repetition on rate of learning, etc.
5. *Application.* Show how these facts explain, "Why we cannot see the stars in the daytime"; "Why a year seems shorter as we get older"; "Why it is fair for taxation rates to increase with the amount of property owned, or the wealth of the taxpayer," etc. Suggest other situations and have the students show how the law explains them. Have the students suggest other situations on which the "psychophysical law" throws light. (Example—the fact that, in advertising, the number of "inquiries" increases approximately as the square root of the size of the advertisement.)

Limitations of the method. 1. Although the formal excellencies of this plan are apparent, it should not be made a fetish, or slavishly followed. Sometimes, informality is best. It may well be that although this logical procedure is best for the *narration* of material, it is not best for the process of *learning* new material.

2. The method overlooks many of the *incidental* values

which many believe should accrue from learning—the attitudes, ideals, preferences, that arise in connection with the topic, the teacher, the school. These incidental character traits may be of as great value as the formal content of the lesson.

3. The method is more favorable for the bright and interested pupils who more readily appreciate logical relationships. The method, after all, does not insure motivation and active interest, but only a *cognitive* understanding, which may not include emotional appreciation.

4. Many contend that this logical order really *violates* the psychological laws of thinking and learning—that natural thought *begins* with a concrete need, steps to a tentative generalization, tries out this generalization on particulars, then compares and *finally* sees the relation of it to old and known data.

5. The method tends to make education always a *preparation* for the future, rather than a *development* of present activities, since the engineering of the process is so largely in the hands of the teacher, rather than those of the learner. Some educators insist that this *preparatory* conception is a very limited and sterile notion of the function of education. It lacks the elements of adventure, active inquiry, spontaneous enthusiasm and intrinsic motivation.

6. The method is scarcely applicable to extra-curricular learning, but applies best to the didactic classroom study of verbally presented topics or artificial experiments and demonstrations. In actual life, one does not usually have time for "preparation," he is quickly faced with a difficulty calling for remedy. The proof of a deduction is not in its logical derivation from foregoing premises but in its actual working value. The recent tendency to incorporate many incidental activities into the recognized work of the school calls attention at least to the value of certain other methods.

The purposive problem method. Taking its cue from the excessive formalism of the Herbartian procedure, and recognizing the failure of this method to apply to concrete situations and to many incidental activities, an active movement in favor of "problem teaching" has developed. This method also assumes to base itself on the "natural laws of thought," as did the inductive lesson. But it is a psychological rather than a logical description that is adopted; an account of how thinking actually goes on, rather than a picture of it when completed.[6]

According to this view thinking is a *dynamic* process, not a mere series of cognitions, not a mechanical play of "ideas." It is the striving, impulsive aspect that comes first. An analysis in terms of "steps" is given, which it is maintained should also be the steps followed in an act of school learning, since this is the "natural" way of thought. The steps may be outlined as follows:

1. An active urge or drive impels us toward a certain end, goal, or accomplishment.
2. An obstruction is encountered, either in the form of our own impotence, or in the form of opposition from other people or the refractoriness of the environment.
3. In the face of this obstruction, which is accompanied by a strong feeling of perplexity, problem or difficulty, the original or *consummatory* drive is held up, while various *preparatory* reactions occur. We cast about for suggestions, seek useful aids or ways out.
4. Either in mental rehearsal, or in active trial and exploration, these suggestions are tried out and rejected or accepted.
5. The successful solution is fixed, as a mode of solution, and the original drive is released for realization. The resulting elation further fixes this mode of solution.
6. The survival of the successful suggestion, and its adoption in connection with the original drive, is a kind of generalization, or a habit of action.

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[6] John Dewey, *How We Think* (D. C. Heath & Co., 1910), is usually cited as the basis of this method; detailed description and illustration is to be found in W. H. Kilpatrick, *Foundations of Method* (Macmillan Co., 1925.)

A much used illustration of this "natural mode of thought" is the following:

Step 1. The mother's fondness for her infant and solicitude for its comfort constitutes a "drive."

Step 2. The baby cries restlessly, disturbing the mother's complacency, and constituting a feeling of problem or difficulty.

Step 3. Mother halts her petting and casts about for an hypothesis —Is it cold? Or colic? Or a pricking pin? There is examination of the situation and definition of the difficulty.

Step 4. Suggested solutions tried out—if cold, more cover will produce quiet, etc.

Step 5. Some suggested solution *works*, and that one is accepted.

Step 6. The mode of solution becomes a generalized and useful bit of information.

An illustration of the problem method. Applied to the process of teaching, this method would result in some such procedure as the following, in the case of the teacher of psychology, interested in presenting the facts of "Weber's Law." This was used to illustrate the method of the inductive lesson, and the contrast may now throw further light on both methods.

1. The teaching of these facts would have to wait until some appropriate drive or urge was in action which would make an appropriate occasion. Let us suppose that the teacher waits until the class, as members of the general college body, becomes interested in making the college paper prosperous and able to pay its own way.
2. Suppose that advertisers in the college paper object to paying for large space and take only small sections of the paper, claiming that larger space does not "pay." Here is a difficulty and a problem. Why is there this feeling; can it be justified; what are the facts?
3. Members of the class are now asked for suggestions. They may make inquiries here and there, and various hypotheses may arise. Among them, perhaps, the following:
    (*a*) The objection to large space is just based on stinginess of the advertisers.
    (*b*) The objection is based on mere tradition, for in the past the managers of the paper have been content with selling small space.
    (*c*) The advertisers do not want to give the impression that they are unjustly competing with one another.

(*d*) There is some actual law governing the attention of the reader, which makes large space yield results according to a "law of diminishing returns."

4. Each of these possibilities must now be investigated in turn, and, if the teacher is clever, the law of Weber may be hit upon, giving strong evidence in favor of the last of these suggestions.

5. Experiments must now be conducted, in various ways, to see how widely the law holds, and whether it is also true of this special field. In so doing the general facts about the psychophysical law of sensation and perception are mastered.

6. These facts can then be used widely in other situations.

Various forms of the purposive problem method. In actual practice in the schools, this general theory is given varying modifications, some of which may be noted:

1. In some cases it is insisted that the teacher must *wait* until the child expresses a *spontaneous* need. This may be, for example, the wish to read a letter from a friend. Whereupon reading may be started as a project. In this extreme form the method is advocated chiefly by certain elementary schools, strongly in favor of "play" methods and "wholly incidental" learning.

2. In more moderate forms of the method, the teacher *sets* problems, such as the "causes of the Civil War." If the pupils can be aroused to sufficient zeal over the topic, the sources are examined and discussed, and in this way the pupils may be led to the *discovery* of the answer.

3. The usual "laboratory method" is in a sense an adaptation of this procedure. Although others have already solved the problems set for the student, he is required himself to *live through* the solution, rather than to accept a verbal or vicarious account of it. This form of the method is much used when it is believed that it is the *habits of work, or the attitude of inquiry that should be acquired as* the result of teaching, rather than specific items of information.

4. The "original exercises" of many texts, such as those on algebra and geometry, also serve as an example of this method in one of its minor forms. Certain demonstrations are provided in the text, and it is hoped that the student will then feel *challenged* to solve the exercises.

5. In a still more diluted form, any arousal of whole-hearted enthusiasm or zeal, as in contests, in striving for prizes, in "spelling bees," and the like, may be said to proceed by first arousing an "initial drive," but by some more or less "extrinsic" means.

6. On a somewhat higher level various forms of "committee work" by the class, the socialized recitation, and the "discussion group" fall in line with this method. The pupils are supposed to be their own teachers, the actual instructor being only a member of the group, or a useful source of suggestions and guidance.

7. In a somewhat more elaborate way the "project method" also represents this general theory. So much attention has been given to this modification of it that we shall devote a special section to its discussion.

The psychology of the purposive problem. What shall we say of the psychological soundness of this method? In the light of our analysis of the nature of motive and purpose, the underlying theory seems needlessly complicated. Actually, as we have seen, all action starts from *motives*, and these motives are *distresses*, *difficulties*, *irritants*, and, essentially, *problems*. Action continues until this initial disturber or motive is reduced or eliminated. This result is what we mean by satisfaction.

But the account of motivation given to support the purposive problem technique is more complex; it involves an awkward and unverifiable description of the basis of human conduct. The *difficulty*, in this account, does not arise until some previous *positive drive* is balked or frustrated. The positive drive is wholly unaccounted for. Presumably it would have to be some "pleasure seeking" tendency; some "instinct," in the old sense of the term. All of this seems to be introduced only in order that activity may actually have a *distress* of some sort as its starting point.

Once it is realized that the native *spurs to action* are always such distresses, the whole account becomes much simplified, and quite in accord with our general analysis of learning. With this revision, the only objection to the method as outlined would then be its wastefulness and its refusal to admit "vicarious experience" as genuine and effective. If, for example, the teacher of psychology actually found it necessary to wait until the pupils became concerned over the financial success of their school paper, before introducing the facts of psychophysics, the chances are he would never get to this topic. And if he actually consumed the time of the students in their futile guessing and exploring, before introducing them to the many available verbal descriptions of the facts, based on the previous explorations of men of science, the term would expire with no other topic than this undertaken.

The method seems best suited, in its extreme form, to very elementary levels where the "subject matter" of instruction may be of little importance—where the chief aims of teaching may be such things as socialization, coöperation, mutual helpfulness and habits of self help.

The project method of teaching. The meaning of the term "project method" varies somewhat with the advocate. We may first note some of the more general and common features of "projects" in education and later consider some of the varieties. In general the project represents a reaction against the standardized and organized curriculum of subject matter, formally arranged in advance by adults for the instruction of the young. Instead of preparing for *future needs* by this roundabout means, the learner is confronted with actual problems which arise in the course of his own life. These cannot be solved except by acquiring certain knowledge or skill, and with the encouragement and guidance of the teacher these particular acts and items of information are thereupon acquired and used.

Instead of teaching the pupil to read, to write, to add and subtract, to know decimals, and the table of money equivalents—he is encouraged to *keep a savings account* and *to budget* his expenditures. In order to do this intelligently he must of course acquire the reading and arithmetical arts, which he does *as needed.*

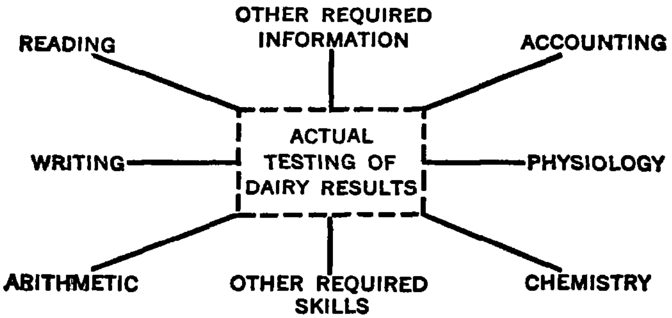
Instead of learning animal nutrition, chemistry, bookkeeping and the like in anticipation of their sometime being useful, he undertakes a study of his father's dairy cattle, showing how milk yield varies with feeding. To do this he must learn to make tests of milk content; study the food content of various grains; record regularly his feeding schedules, correlate these with the yields, write up the returns. Enthusiasm for the project is relied on to lead the pupil to master the necessary techniques when he needs them.

Instead of a "curriculum," taken "subject by subject," and more or less out of relation to immediate use, the project "cuts across the curriculum." The course of study would be an array of such projects, through which, in the course of time, all the needed information and skill would be acquired in the course of actual living, rather than through classroom recitation and purely verbal learning.

The traditional method might be represented by the following diagram—

1. Reading
    2. Writing
        3. Arithmetic
            4. Bookkeeping
                5. Physiology
                    6. Chemistry
                        Resulting, it may be hoped,
                        in ability to test dairy cattle

The project method would instead be diagrammed in the following way.



Characteristics of the method. Among the various arguments in favor of this procedure[7] the following are the most important. They have often been expressed by way of contrast with the traditional method of the organized curriculum and the more formal methods of instruction.

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[7] A useful reference in this connection is J. A. Stevenson, *The Project Method of Teaching* (Macmillan Co., 1925).

(*a*) The method takes advantage of *actual activity* as contrasted with the technique of *verbal learning.*
(*b*) It favors learning in terms of *present needs* rather than preparation for remote and *hypothetical needs.*
(*c*) Learning is conducted in a *natural setting* or context, rather than in *artificial* school situations.
(*d*) Complex and *concrete activities* take the place of abstracted *subject matter.*
(*e*) Learning consists in the actual *modification of conduct,* rather than in the mere *accumulation of information.*
(*f*) Learning is *motivated from within,* intrinsically, rather than *enforced* by the demands of the school authority.
(*g*) Learning is more likely to accord with juvenile thinking, a *psychological order,* rather than with the *logical* standards of adult reflection.
(*h*) *Problem solving* is emphasized rather than *memorization,* and incidental, strongly motivated learning, rather than drill.

As the method is ideally conceived, the teacher ceases to pose as drill master and curriculum maker. Instead he becomes an arranger of projects, a guide and source of information and suggestion. He must play some part in the arrangement of projects, since after all he is supposed to have some more or less correct notion of what array will best equip the learner with the skills and knowledge to handle projects not actually undertaken in the course of learning.

The task of the pupil also becomes much changed. Instead of undergoing a "schooling," which may or may not be related to life, he begins to live. Theoretically he should never cease the process; he should continue to live more and more completely, and "graduation exercises" would become meaningless. Through the actual solving of genuine problems he is expected to become an effective "problem solver," and this is conceived as being the ultimate objective of education.

Variations of the project method. Actually this ideal is usually only approximated in those teaching activities ordinarily called projects. The projects are often not genuine life situations at all, but enterprises devised by the teacher, accepted by the pupils and then developed. No ordinary child, for example, if left to himself, would be likely to undertake the supervision of the feeding of his father's dairy cattle. Nor would he keep a savings account and budget his expenditures. Only the very bright might be expected to find in such activities real life situations.

The character of "projects" varies not only with the limitations and resources of the school and the teacher, but also varies with the notion held concerning the nature of a "project." According to some accounts "drill in multiplication" becomes a project, providing the pupils can be persuaded that it is worth the doing and can be induced to set about it with a *will to learn.*

So varied are the conceptions and definitions of what the project method is supposed to be that a few definitions of the term, suggested by leading educators, may be cited with profit.[8]

1. For many years the term "project" has been used to designate carefully planned investigations in agricultural science, covering a considerable period of time, frequently demanding several years. (Heald)
2. [The word project is used] to describe a unit of educative work in which the most prominent feature is some form of positive and concrete achievement. (Snedden)
3. A project is (*a*) something to be done, (*b*) under specified conditions and for a specified valuable result, and (*c*) requiring a thoroughgoing training. (Stimson, Allen and Prosser)
4. A project is a concrete problem outlined sufficiently fully and clearly to enable the student, for whom it is designed, to carry it out. (Drushel)
5. A problem, the solution of which results in the production of some object or knowledge of such value to the worker as to make the labor involved seem to him worth while. (Randall)

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[8] For further accounts and a detailed analysis of the project method see Stevenson, *op. cit.*

6. A complete unit of experience. . . . Such a unit includes the following phases:—situation, problem, purpose, plan, criticism of the plan, execution, judgment of results, appreciation. (Hosic)

7. A project is a life topic in which the processes and objects of learning are largely manual. . . . A problem is a life topic in which the processes and objects of learning are largely mental. . . . An appreciation unit is one in which the processes and objects of learning are largely emotional. (Stone)

8. Any purposeful activity determined upon and carried to a successful conclusion becomes a project. (Krackowizer)

9. [The project is to be defined as] whole-hearted, purposeful activity, proceeding in a social environment, . . . or, more briefly, the hearty purposeful act. (Kilpatrick)

10. A project is a problematic act carried to completion in its natural setting. (Stevenson)

The psychology of the project. A survey of these and numerous other conceptions of the essential characteristics of the project method suggests two main features as outstanding and fairly well agreed upon.

Certain definitions stress the *concreteness* and *practical* nature of the act—it is active, valuable, practical, manual, successful, conducted in its natural setting, and the like.

The remaining definitions (although some include both aspects) emphasize instead the *problematic* and *purposeful* character of the activity—it is whole-hearted, purposive, worth while.

The second characteristic, at least, may be present in educational situations not conforming closely to the first feature. Thus in higher education, for example, *education itself* may become a project, even when chiefly verbal, and not closely related to activities outside the library, classroom or laboratory.

On the other hand, in many respects higher education inevitably conforms to the project definitions; the work of the writer, chemist, surgeon, is actually carried on at the desk, in the laboratory, the library, the clinic, the lecture room. It must, however, be said that this is most distinctively the case when the higher education is professional or definitely vocational in character.

The problem largely reduces itself then to the question of the status of the project in elementary education. Here it must be admitted that much of the traditional curriculum does seem to be unrelated to life; moreover, much of the work of the school may be conceived as not relating directly to subject matter, but to the business of socializing the individual, providing a healthy and otherwise favorable set of surroundings for early development, and the aspect of "parent relief" should not be wholly forgotten.

In modern urban life it is very difficult for children to get their feet on the ground; they are far removed from the raw base of supplies; they do not even become familiar with the sources of their daily foods, garments, toys; the many incidental advantages of frontier life and rural activity are denied them. The introduction of practical projects, involving active, manual and concrete enterprises might easily be defended on this ground alone.

The argument that learning is by this method tied directly to the individual needs and distresses is a sound one. This feature, when actually realized, gives sound psychological warrant to the project method as a device for promoting relevant and effective learning, in which the act accomplished actually relieves an initial irritant.

Certain elements of waste and perhaps also of dishonesty easily creep into the application of the method, however ideally it may be conceived in principle. The so-called individual projects are often wholly artificial and manufactured by the teacher; the usefulness of vicarious experience, and the capacity to profit quickly from the recorded experience of others, without going through the random exploration, are often neglected. Furthermore the teacher usually has a clearly formulated *curriculum* in mind, in terms of which the projects are really set, and in terms of which the ultimate tests and ratings are administered.

Social possibilities of project teaching. The use of the motivated project technique may react not only upon the individual character and resources of the pupils; it may penetrate into the social life of the community as well. Perhaps this is one of the greatest virtues of the honestly planned and executed project scheme in education.

In a small lumbering town the yards were full of stumps; the houses were unpainted, and unsightly; esthetic interests of the community were low; civic pride related more closely to the production figures of the mill than to the immediate conditions of life.

A vigorous principal introduced into the school system a well conceived project system, centering about wood-working with the boys and domestic arts with the girls. The community was induced to provide the necessary materials through school funds or contributions on the condition that completed projects should become the personal property of the pupil and his or her family.

Furniture of excellent quality and appearance was shortly being made by the boys with enthusiasm and pride. Dresses, hats, and foods, all of excellent grade, became the pride of the girls. The school exhibits took prizes in various parts of the state. Ordinary curricular achievements were up to standard expectations.

When these products were finally placed in possession of the pupils' families, notable changes speedily appeared in the community. The elaborate and beautiful cabinets, tables, desks, chairs; the decorative dresses, hats, the exquisite foods seemed quite out of place in the miserable surroundings. Houses were soon painted, interior decoration was attempted; stumps were extracted and patches of lawn took their place. Standards of appearance and of home comfort rose markedly, not through any particular additional expense, but chiefly through a new interest in living conditions that could be gratified by a little personal effort and attention. The experience of this community was a striking example of the effective way in which the school may be able to make itself a positive contribution to society.

Discovery versus learning, again. We have already emphasized the difference between investigation (initial experience, discovery), as an aspect of education, and learning or improvement. In some respects the purposive problem and project methods assume that the former, discovery, is more important than the latter, learning. The work of the school is conceived to be chiefly that of making better explorers, better initial problem solvers.

This distinction, or rather the failure to make it, is at the bottom, also, of a long controversy that has gone on between the advocates of the "insight" school and the "connection forming" school in educational psychology. The former emphasize the *first achievement* and are less interested in the process of subsequent improvement. The latter conceive even initial experience as a process of "connecting" and look upon subsequent improvement as nothing but the bettering of these initial connections.

The purposive problem and project methods are less concerned in problems of the technique of mastery than in those of the technique of getting initial experience in effective ways. It is clear that education cannot afford to neglect either of these aspects. It is the custom, in purposive problem and project teaching, to introduce the "remedial teacher" toward the end of the term, who by intensive diagnosis and drill makes good the neglect of learning that has characterized the preoccupation with methods of discovery.

PROBLEMS

1. What other classroom methods might have been discussed in such a chapter as this?
2. Find and report to the class what the Winnetka plan, the Dalton plan, the Batavia plan, the Montessori method, and the socialized recitation are.
3. If the method of apprenticeship is used in your neighborhood, investigate and report the details and results of its use.

4. Are some of your own studies more definitely related to your life-career motive than others? In which do you do the better work?

5. Show just how flash cards might be used as aids to drill in arithmetic.

6. Can you devise a way in which the purposive problem method might be applied to the work of this course in educational psychology? How well would you expect it to work?

7. How might one attempt to apply the project method on the level of college education?

8. Find in the literature some description of actual project teaching and report to the class the details and outcome. Are the conclusions scientifically reliable?

9. Choose some subject or field in which you expect to teach and draw up a detailed plan for a problem or project unit.

10. If you have been taught by more than one of the methods described in this chapter, what is your opinion of their merits?

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CHAPTER XI

MEASUREMENT IN EDUCATION

The need for measurement. In the absence of measures, the educator has only "impressions." Impressions vary from person to person, and with the same person from time to time. Is a pupil bright or dull; balanced or unstable? Is a composition poor, good or excellent? Teachers once assumed an infallibility that was supposed to enable them to render such judgments and on them to base the treatment and the destiny of the pupil. We shall see (in Chapter XII) that teachers and parents cannot reliably judge the dullness or brightness of children by applying such adjectives in an impressionistic way. The reasons are many.

People do not have the same *standards;* the words they use have different *meanings;* different judges do not have the same *evidence* on which to base their impressions; personal *feelings* also enter to bias the estimates; often the *data* relied on do not reflect the trait that is being judged; even when the data are relevant, they may result from a *variety of causes.* Poor work in arithmetic may be due to carelessness, excitement, indifference, worry, deafness, dullness, mischief, or any combination of these or other factors.

It might therefore be suggested that, if ratings are necessary in education, the *product* rather than the *pupil* should be the object rated. The causes of the high or low rating would then be a matter for further investigation. But several classical studies of teachers' marks have shown how unreliable even the estimates of school products may be. In the following graphs are shown the distribution of such marks or grades when different and presumably qualified teachers independently rated the quality of examination papers submitted by

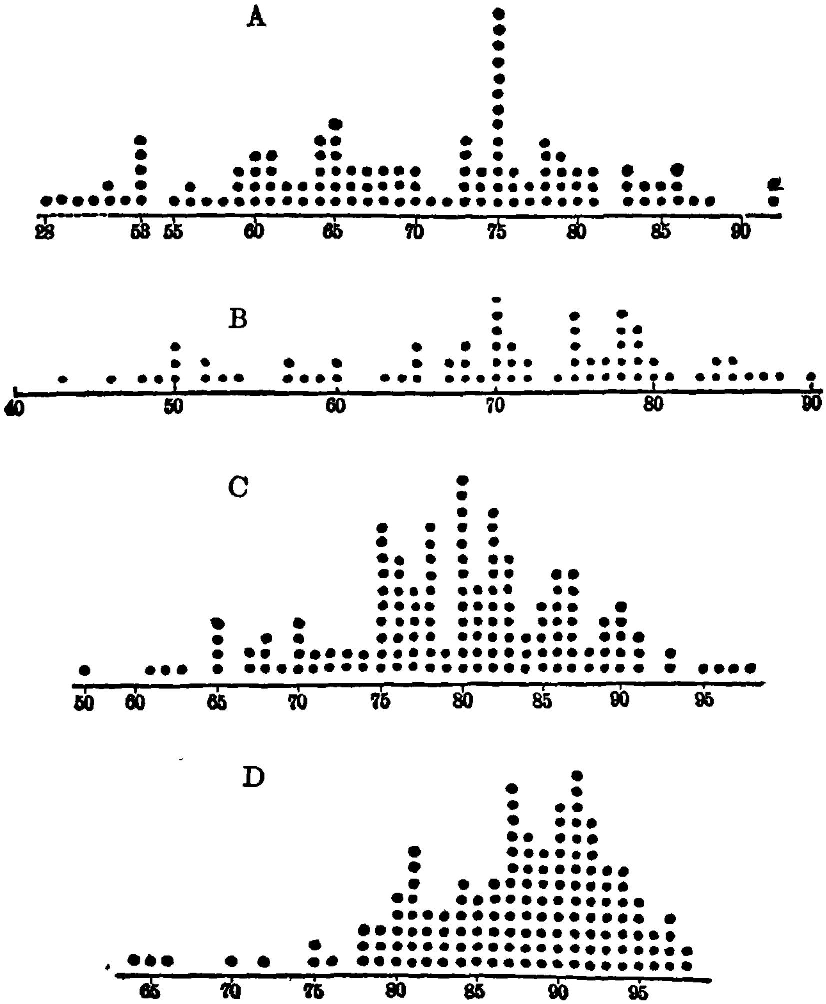

FIG. 35.—FOUR STUDIES OF DISTRIBUTION OF TEACHERS' MARKS.

A. Distribution of marks assigned by 114 mathematics teachers to a final examination paper in geometry.

B. Distribution of marks assigned by 70 history teachers to a final examination paper in American history.

C. Distribution of the marks assigned by 142 English teachers to another final examination paper in high-school freshman English.

D. Distribution of the marks assigned by 142 English teachers to a final examination paper in high-school freshman English.

From Daniel Starch and E. C. Elliott, "The Reliability of Grading High School Work in English," *School Review*, Vol. XX, pp. 442-457.

high school students. Diversity of teachers' ratings may not always be so great as in these cases, and it may be possible, in a given school system, by special instruction and effort, to reduce such variability to narrower limits. But such methods are not usually adopted, and students of education have come to distrust the meaning of "school marks" when these are derived from different sources. It seems clear that measurement of products is as desirable as is measurement of the traits of the pupil.

Reliable appraisal of teaching and dependable knowledge of the traits of the pupil, and perhaps of the teacher, are needed for intelligent instruction, guidance and administration. Since the mere impressions of the educator can in neither case be relied on, the need for techniques of *objective* measurement would appear to require no further argument. A survey of educational psychology should introduce the student to some of the general aspects of the complex technical field now known as mental and educational measurement. Such a survey can hope only to direct attention to the many issues and the variety of techniques, constituting a highly professionalized specialty which coöperates at many points with the classroom teacher and the administrator.

Some of the problems of measurement. Some of the problems of measurement may be clearly seen if we suppose that we wish to measure the *learning ability* of a given pupil. Since there is no such *entity* as an ability, we cannot single out learning ability and measure it directly in the way that we could measure height or weight. The most that we can do is to measure some or other feature of actual learning *activity.*

But even this is a vague abstraction. Although there is on the whole a positive correlation of different acts of learning, the correlation is far from complete. One individual will learn to play the violin with difficulty, but may learn to drive a motor car more easily, as compared with other people. Although we can in a useful sense talk about the *general* capacity for learning, in the case of an individual, this will refer either to some specified type of learning, or else will be an *average* of all his various learnings. The general learning ability of a pupil is much like his general health, which is a net resultant of the healths of his various organs and systems.

What we have to do practically is to start with some *specific* learning activity. An example would be code-learning, with the substitution test, to choose a very narrow and easily identifiable case. If we can measure learning ability as shown in this performance, we can then proceed to a different performance, and secure in turn a measure of it. Having in some such way *sampled* the learnings of the individual, we could be in position to say something about them *in general.* Or we might discover some single activity which best *represented* the general trend of all of them and use this as a useful single index.

The measurement of a single activity. But we cannot directly measure learning *ability* even in the single substitution test. What we can measure is *performance.* If we take care to supply favorable or standard conditions, clear or standard instructions, reasonable or standard coöperation and motivation, we may make from this measurement of performance an *inference.* On the assumption that the individual has completely exercised his ability, we can infer the quality of it or the amount or degree of it. Or perhaps we can more safely say that what we really want to know is not how well he can learn but how well he does and will.

Suppose that we start, then, with a substitution learning test. We wish to measure the individual's learning in this process. But such an activity has several variables, such as the rate at which it goes on, the accuracy of the performance, the level of difficulty which it represents, the permanence of the learning after practice has ceased. If we can keep all but one of these variables constant, or reasonably so, measurement of that one will at least give us an index. It is usually impossible to keep all the other variables absolutely constant, but this is an ideal to be striven for.

Suppose this to be done. We require perfect accuracy in the substitution; we maintain a constant motivation; we keep constant such other conditions as we can control. We then take *time* as the variable we are interested in. And we may find that this individual learns the new code at a rate which enables him to complete the test in twenty seconds.

The need for standards. At this point we have, to be sure, measured the time of the individual's learning performance. But we are not in position to say much about it. The "raw score," the number of seconds required, does not even tell us whether this is a good or a poor record. We have measured its *duration,* but not its *quality.*

Measurement always requires a standard. The standard in measuring the *time* of performance was provided by the timepiece we used. If this standard was not reliable, neither is our measurement, no matter how carefully we have recorded it. Similarly, in order to go from this stage to the measurement of the *excellence* of the performance, we must have a standard of excellence. We must at least have *other measures* with which this one may be compared.

These other measurements may be earlier records from the same individual; we could then say that his performance to-day is either better or worse than before. If we had several other measures of this individual, we might take their *average,* and thus be able to say whether to-day he is up to average or not. But in all this the individual would be his own standard. It is often more important to know whether these performances *as a whole* are good or poor. This requires that similar measures of *other learners* be available. The relative measure, the comparison of this individual with others, is likely to be more instructive than the absolute number of seconds required by him.

Sources of standards. But it will not do merely to take *some* other individual at random. Or if we did, it would be necessary thereafter to preserve that individual as a point of reference, in the way that standards of length or weight are preserved in the Bureau of Standards. Since this cannot be done, mental measurement has resorted to an ingenious method of maintaining standards without preserving them. Since human nature remains much the same if the whole array of abilities is considered, the distribution of ability in a group of an individual's peers, or the average of the abilities of such a group (say, 9-year-old American white children) serves as a convenient standard.

Such an average or distribution can always be secured, and can be made reliable if a large enough sample of the proper population is taken. Thus 9-year-old children have much the same stature in California that they do in Maine, and in 1932 that they did in 1860. But even if this is not precisely the case, it still remains true that the best standard for the measurement of any individual is the measurement of other individuals with whom it is useful to compare him. This makes it possible to assign each his place in the distribution of abilities. Any given measure can then be described in quality or excellence by showing where it would belong in such a "surface of frequency."

Backgrounds for interpretation. In previous chapters we have considered two such methods of measuring individuals. In the one case (Chapter VI) we found the average score of individuals at different ages. In this way we were able to assign an age level to the performance of any pupil, if the "raw score" had been secured. This also enabled us to compare different traits in the same individual.

Developmental units of this sort are at present much used in education. If we can measure, in terms of "raw scores," a pupil's knowledge of geography, we can compare this with scores of other pupils of various school grades and thus find a "grade status"—say fifth-grade knowledge. If average fifth-grade achievement in geography has a reasonably stable character, this enables us to state a valuable fact about the quality of the pupil's achievement. Age status and grade status are both examples of "developmental units."

In the other case (Chapter VIII) we showed the scores of a group of college students in the substitution learning test by means of a graph of frequency. The unit on the base line was the distance (in time or score) we had to go, above and below the average, to include half the number of cases. This distance, in either direction from the "central tendency," was called the "probable error" of the distribution. Knowing, from the statistical and mathematical properties of the frequency curve, the number of cases to be found at each distance from the average, we were thus enabled to evaluate the quality or excellence of the individual score in terms of its frequency of occurrence, its rarity.

We were able to assign the individual either a rank or a percentile standing in the group, or to show how many "P.E. units" he stood above or below the average of the group. It is some such relative placement of an individual in a group of his or her peers that is most instructive to the educator, who has the whole group before him and yet must consider the individual differences among the members of that group.

We need not go further into the refinements of statistical procedures. These constitute in themselves an elaborate educational specialty.[1] For our purpose it need only be clear that measurement always involves some *background* of other scores, in terms of which any given case is to be evaluated.

The most generally usable background is that of the representative distribution of a large group of the individual's peers. This background may be all the members of some specified group; or all pupils of a certain age; or all of a certain grade; or even *all* the members of the human race, of different ages, as in the case of the method of developmental units.

Scales and instruments. Much activity has gone into the development of "absolute scales" for mental and educational measurement. These would be scales consisting of items or accomplishments arranged in series. At the low end would be an item with just zero value. Higher items would then differ from adjacent ones by some sort of equal steps. For stature we have such a scale—the yardstick. Absolute zero would be just no stature, and the successive inches are all equal in length. The step from one to the other is equal to any other such step.

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[1] For an account of the use of statistical methods in education see H. E. Garrett, *Statistics in Psychology and Education* (Longmans, Green & Co., 1926).

In a similar way scales for measuring penmanship, drawing, composition and other school products have been devised.[2] These are a great convenience. They correspond to the timepiece in the illustration we have been using. But we have seen that even with such an instrument the raw scores have no useful meaning. To say that a pupil's penmanship on a certain handwriting scale is 6.5 points means nothing more than this, unless there is a background of scores by means of which such a number may be interpreted.

It is, of course, possible to do many things with such scores that cannot be done with mere subjective impressions of quality. They can be added, averaged, subtracted, in ways in which simple impressions cannot properly be treated. But none of this juggling of figures has any meaning until some background of evaluation or interpretation is provided.

Furthermore, steps on such a scale, said to be equal, are usually equal only in some specified respect. Thus the steps on a scale of handwriting may be *equally perceptible;* but they may not be equal in any other respect. They may not, for example, be equally important, or equally easily achieved as individual performances. This does not disqualify them as scales. It may take longer to grow from 60 to 61 inches than from 24 to 25 inches, in height. The difference of one inch is not *biologically* the same, although it is *spatially* the same.

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[2] It will be useful at this point to examine some scales of this kind, such as any of the scales for penmanship, drawing, handwriting, spelling, composition, sewing, etc.

Absolute scales, of time, of extent, of quality, or of any other feature, are then only the beginning of useful measurement. But they are an indispensable beginning, without which measurement, in the sense of meaningful description, cannot proceed.

The measurement of general ability. There is a general quality of the organism that shows itself in all its functions. In educational activities this general factor is called intelligence, as distinguished from information. It is aptitude for education. Dependent on both learning and scope, it is best expressed in activities involving reduced cues or symbols. The variety of scales for measuring intelligence is great, and the following descriptions will serve only as samples to suggest their general character.

The Binet Scale, as adapted and extended by Terman (Stanford Revision)[8] and by others in various lands, is a favorite individual test. For each age level there are provided a set of tasks, problems or questions, found by experiment to be capable of achievement typically by that age but not below. As would be expected, these tasks mainly call for the use and understanding of symbols, symbols of things and relations, and relations of these symbols—words, numbers, pictures, diagrams, meaningful acts.

Carefully standardized instructions for presenting and scoring each problem are provided. The tests themselves give the background for interpretation, since they are grouped on age levels, from 3 to over 16 years, on the basis of the performance in them of representative samplings of children of each age.

The examiner begins with a level which he guesses to be about the child's developmental plane. He then proceeds downward to levels where no failures occur, and upward to levels where there are no successes. The individual's performance level is then found between these two extremes and is stated as a "mental age." If he is chronologically under 16 years of age, a quotient may be derived by dividing his mental age (M.A.) by his chronological age (C.A.) and this is called his Intelligence Quotient (I.Q.). If an Educational Age (E.A.) is also available (see the later sections of this chapter) this may be divided by the chronological age to give an Educational Quotient (E.Q.). If then the E.Q. be divided by the I.Q., this gives an Accomplishment Ratio (A.R.), which shows the degree to which the pupil's educational achievement approximates the level which his ability justifies. The distribution of I.Q. in a large and representative sampling of the population will be according to the graph shown on page 177.

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[8] See L. M. Terman, *The Measurement of Intelligence* (Houghton Mifflin Co., 1916, and later revisions).

Planned in much the same way, as a heterogeneous and miscellaneous array of apparently unrelated tasks, are various other scales for developmental progress. The Kuhlmann[4] series provides for ages below three years, where the Stanford Revision begins. Developmental schedules for very young infants are found in the Gesell[5] lists and in the Baby Tests of Bühler and her collaborators.[6] All these may be traced back to older arrangements of developmental indices suggested less systematically and less reliably by early students of child psychology.

Group tests of intelligence. The Stanford Binet is an "individual" test, requiring that an examiner spend a half hour to two hours with each pupil, depending on the age. Group tests are also much used, in which oral or printed instructions can be given to a whole class in times varying greatly with the system or scale used. These are most often "paper and pencil" tests, each pupil being provided with a separate booklet, made up of sets of problems calling for mental work.

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[4] F. Kuhlmann, "Revision of the Binet System," *Journal of Psycho-Æsthenics,* Monograph Supplement No. 1, 1912.

[5] A. Gesell, *The Mental Growth of the Pre-School Child* (Macmillan Co., 1925).

[6] Charlotte Bühler, *The First Year of Life* (John Day Co., 1930).

The Army Alpha Test,[7] devised first for adults in military service, is a pattern after which many such tests have been modeled. The test blank contains eight pages, each bearing problems of one kind, gradually increasing in difficulty down the page. A fixed time is allowed for each set of problems and the score is based on the number of items successfully done. The sets of tasks are as follows:

1. A series of twelve instructions concerning marks to be placed at proper places in rows of printed forms on the page.
2. A series of arithmetical problems to be solved.
3. Choosing the best of three reasons or answers for certain propositions or questions.
4. Indicating whether forty word-pairs are opposites or synonyms, as:

   CHASM—ABYSS Same Opposite
5. Indicating the truth or falsity of propositions the words of which are jumbled and have to be correctly organized before decision, as:

   OIL WATER NOT AND WILL MIX True False
6. Number series completion, the first six steps being given, as:

   8,9,12,13,16,17, ?, ?.
7. Analogies, underlining the one word of four that completes a logical proportion, as:

   EGG: BIRD:: SEED: (grow, plant, crack, germinate)
8. Information test, a series of exercises such as:

   DENIM IS A dance—food—fabric—drink

These activities clearly involve both cue reduction and scope. The materials are verbal or other symbols, to be reacted to in the light of their relations and meanings, under the control of other symbols occurring in the context. They therefore conform well enough to our general account of the composition of intelligence.

The score is the total number of "points" achieved, and various tables of norms are available as backgrounds for interpretation and comparison. Distributions of scores for adults make it possible to locate an individual in such a group. Similar distributions are available for college students, high school pupils, men in different occupations. Equivalents in terms of "mental age" for younger children are also provided. There is probably more information available for interpretation of scores in the case of this test than for any other now in use.

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[7] The most convenient reference is R. M. Yerkes and C. S. Yoakum, *Army Mental Tests* (Henry Holt & Co, 1920).

Many similar scales, varying in content and arrangement, and varying also in reliability and validity, have followed the widespread use of Army Alpha. Among these are tests constructed by Otis[8] who was one of those responsible for the organization of Army Alpha. The National Intelligence Tests, constructed by a committee affiliated with the National Research Council, followed the Army Alpha and are better suited for young school children. Similar intelligence tests by Terman, Haggerty, McCall, Myer, Trabue, Pintner, Thorndike, and various other psychologists are also widely known and used.[9]

More elaborate and statistically refined group tests belonging in this general classification are the various scholastic aptitude tests, college entrance mental tests, such as those devised by Thorndike,[10] and by the College Entrance Board and various universities.[11] In some cases these scholastic aptitude tests include also material intended to reveal special knowledge of school subjects as well as general mental ability.

Another type of general ability test is the "performance test," as illustrated in the series of Pintner and Paterson,[12] and various other systems of non-verbal tests. Instead of pencil and paper materials, objects such as pictures, blocks and form-board are mainly employed. Mazes and puzzles are sometimes used. Problems are set involving the arrangement and manipulation of such objects in terms of spatial patterns, temporal relations, or combinations of both. Each test may be separately standardized on an age basis, or otherwise, and may be independently considered. Or they may be combined in various ways, and median or average ratings secured.

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[8] A. Otis, *Self Administering Tests* (World Book Co.).

[9] See R. Pintner, *Intelligence Testing* (Henry Holt & Co., 1930), for a useful list of such tests, references, and chapters on the results of the use of intelligence tests in various fields.

[10] E. L. Thorndike, "Intelligence Examinations for College Entrance," *Journal of Educational Research*, Vol. 1, pp. 329-337.

[11] L. L. Thurstone, "Mental Tests for College Entrance," *Journal of Educational Psychology*, Vol. 10, pp. 129-142; Annual Reports, Commission on Scholastic Aptitude Tests, College Entrance Examination Board, 1925-1931.

In Pintner's [13] Group Survey test, this method of combining tests, each of which is also separately standardized, is used for materials more symbolic in character. A similar collection is given by Pyle.[14] A great number of tables of norms and directions for separate tests are described in Whipple.[15]

Such provision for the separate measurement of activity with different kinds of material and different processes or operations seems likely to be the line along which permanent progress will come. It affords a better opportunity for the detailed analysis of the mental pattern of the individual, and just as good a summary index, as do the miscellaneous scales which can yield only the latter measure. It was this method that was used in our account of the psychographs of three pupils in Chapter IX.

The measurement of special abilities. Aside from the scales for special school achievement to be described later, progress has also been made in devising tests for special capacities not closely correlated with general ability. The Seashore Tests [16] of Musical Capacity are among the best known.

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[12] Pintner and Paterson, *A Scale of Performance Tests* (D. Appleton & Co., 1917).

[13] R. Pintner, *The Mental Survey* (D. Appleton & Co., 1918).

[14] W. H. Pyle, *The Examination of School Children* (Macmillan Co., 1913).

[15] G. M. Whipple, *Manual of Mental and Physical Tests* (Warwick & York, 1915), Vol. I, *Simpler Processes;* Vol. II, *Complex Processes.*

[16] C. E. Seashore, *The Psychology of Musical Talent* (Silver, Burdett & Co., 1919).

Standard materials, provided on phonograph records, make it possible to examine either individuals or groups in pitch discrimination, tonal memory, sense of rhythm, sense of time, judgments of sound intensity, and tonal consonance.

Scales for the measurement of drawing ability of several types have been devised. The Burt[17] scale, in which a man is the object drawn, provides an actual drawing as the typical standard of excellence for each age level. In the Thorndike[18] drawing, scale specimens are arranged in steps, all the items representing approximately equal advances, on the basis of the estimates of a number of judges. A scale of this sort requires a background of scores before any significance can be attached to the measures. Other scales of drawing have been devised, such as for mechanical drawing. The various scales for the measurement of penmanship might also be included in this classification.

Goodenough[19] has made ingenious use of drawings as material for the measurement, not of drawing ability, but of general intelligence. A drawing of a man, made by the pupil, is scored on some 53 points on the basis of the details it includes. Such scores correlate closely with mental age, irrespective of the excellence of the drawing as such.

Scales for the measurement of "artistic appreciation" have also been developed, such as the Meier-Seashore[20] and the McAdory test. These require judgments of relative merit to be passed on the design and arrangement of pictures, the appropriateness of dress, ornament, and the like. The score depends on the closeness of agreement with the judgments of trained artists.

Along lines of mechanical ingenuity, constructiveness and interest, various sorts of material have been roughly standardized into the form of scales. Such tests shade gradually into the standardized trade tests [21] used in industry and in the military service, and also into types of tests for occupational fitness, such as those for typists, stenographers, and clerical workers.

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[17] C. Burt, *Mental and Scholastic Tests* (King, London, 1922).

[18] E. L. Thorndike, *A Scale for the Measurement of Drawing* (Bureau of Publications, Teachers College, Columbia University, 1913).

[19] F. L. Goodenough, *Measurement of Intelligence by Drawings* (World Book Co., 1926).

[20] N. C. Meier, "Æsthetic Judgment as a Measure of Art Talent," University of Iowa Studies, Vol. 1, p. 19, August, 1926.

Among tests for special aptitudes might also be placed numerous devices for measuring memory, attention, imagination, community of ideas, verbal association, handling spatial relations, and various tests of sensory acuity and discrimination, and of the speed, strength and accuracy of movement.[22] These in turn shade gradually into tests and scales for special school skills and information, such as vocabulary tests, language and completion tests, tests of reading, arithmetic, spelling, and like activities.

The measurement of emotion and character. It cannot be said that emotional and character traits are yet measurable. Many "tests" for such traits as emotional balance, emotional maturity, introversion, persistence, submissiveness, social perception, honesty, coöperativeness, suggestibility, interests, have been proposed. Many of these have offered promising leads and yielded interesting experimental results. Some of them have been sufficiently developed so that comparisons of *groups* may be made with some instructiveness. The student of educational psychology will find it profitable to keep in touch with developments in this field, as these proceed to the point where individual diagnosis and measurement become feasible and reliable.

For practical purposes, in teaching and administration, we are still forced to rely largely on "impressions" and inferences from spontaneous behavior in estimating character and personality traits. Various devices, such as rating scales, may give somewhat greater reliability and perhaps greater validity to such impressions. But even these cannot be said to afford measurements, and they often serve merely to disguise the actual subjectivity of the data being used. They may give greater clearness to our verdicts, increase the consistency of judgment, and teach us to be skeptical of our subjective estimates.[23]

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[21] J. C. Chapman, *Trade Tests* (Henry Holt & Co., 1921).

[22] Whipple, *op. cit.*

The measurement of school achievement. The measurement of the result of instruction is in certain respects more feasible than the measurement of the pupil, since it is more direct. Such measures are limited to the appraisal of a product and do not require inference from this to the ability of the producer. Once measured, however, the score invites useful questions concerning the factors responsible for it. If a pupil's arithmetic paper is "poor," is this because of the dullness, apathy or illness of the learner? Is it the fault of the teacher, of the method of instruction, of the curriculum? If school products, such as the merit of a recitation, the knowledge of a field, the excellence of a skill, can be measured reliably, many important problems of pedagogy, of method, of administration, may begin to be solved on an experimental and demonstrable basis.

We have seen how unreliable are the subjective impressions of teachers when asked to rate the quality of an examination paper. Aside from such refinements of grading as may come from discussion of standards, use of rating scales, and similar efforts, the chief advance would seem to be through the development of objective and impersonal methods of examining and scoring.

An early form of objective test is described in Chapter XIX in which the planning of a spelling curriculum resulted in lists of words of known difficulty. Actual record of errors made by pupils of various ages and school grades on these lists give norms or standards of comparison. If the standard lists are used in the proper way (without special coaching for them) any pupil's spelling achievement may in this way be compared with that of his peers, and the quality of his achievement measured in objective and impersonal terms. In the same way the work of one grade, or of one school, may be compared with that of others. The effectiveness of methods, of teachers, of motivation, and other influences may be experimentally studied.

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[23] H. L. Hollingworth, *Vocational Psychology and Character Analysis* (D. Appleton & Co., 1929), gives a detailed survey of the methods and results in this field.

Progress in the derivation of such scales has been rapid, and nearly every school subject, from the habits of kindergarten children to the subject of educational psychology, has shown such developments. A few samples of these scales, relating chiefly to arithmetic and reading, will suffice to show the variety of these procedures. There is really a long history behind them.

As early as 1864 an English schoolmaster proposed and devised a "Scale Book" in which standard achievements, with numerical ratings, were preserved for use in evaluating the work of new pupils. About twenty-five years later Kraepelin and his pupils, engaged in psychiatric work, attempted to devise scales for the measurement of the status and changes in school knowledge in hospital patients. In the early years of the present century the work of Rice in spelling, Stone, Courtis and Woody in arithmetic, Thorndike in penmanship and drawing, Hillegas in composition, Ayres in spelling, aroused interest in the use and development of school achievement tests and scales in many fields.

Measurement in arithmetic. Courtis [24] began by arranging, on separate pages, problems of about equal difficulty and calling for the same "operation" (as adding, subtracting, multiplying, dividing). A fixed time being allowed for each test sheet, the score in terms of number attempted and number correct served to indicate the speed and accuracy with which such problems, of that degree of difficulty, could be done. Scores accumulated from many children in various school grades of numerous cities served as the background for giving meaning to such measures.

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[24] S. A. Courtis, "Standard Scores in Arithmetic," *The Elementary School Teacher,* Vol. 12, No. 3, pp. 127-137; also *The Courtis Tests in Arithmetic,* Sec. D, Subd. I, Part II, Vol. I, of Report of Committee on School Inquiry, City of New York, pp. 389-546.

The Cleveland Survey Arithmetic Tests [25] are planned in a more complex fashion. Different *levels* of difficulty in the fundamental operations are represented, and the "spiral" method of presenting the problems is adopted. Instead of working steadily on addition the pupil works on all the operations on the first difficulty level and proceeds, as the test continues, to higher and higher levels in all the operations. A greater difficulty or *power* range may in this way be introduced into the instrument, as well as the mere determination of *rate* on a fixed level of difficulty.

In the Woody Arithmetic Scales [26] this element of *power* as distinguished from *rate* is especially featured. The problems used have been tested for their relative difficulty in different school grades. The scales, for the four fundamental operations, contain problems arranged in steps of increasing difficulty. Time limits are used which enable each pupil to show how far up the scale he is able to work. The emphasis is thus on the complexity he is capable of handling rather than on the speed of his computation.

The Stone [27] Arithmetic Reasoning Tests differ from all these in that they are more than simple measures of computation. The problems are stated in a paragraph or sentence, but no indication is given as to what operation is required. The choice of operation as well as the actual computation depends on the pupil's discernment of the various cues offered by the problem. Such tests measure not only the degree of drill (cue reduction) but also emphasize the factor of scope or sagacity (joint operation of all the cues the problem and its statement affords).

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[25] C. H. Judd, *Measuring the Work of the Public Schools* (Russell Sage Foundation), pp. 94-123.

[26] C. Woody, *The Woody Arithmetic Scales* (Bureau of Publications, Teachers College).

[27] C. W. Stone, *Standard Reasoning Tests in Arithmetic* (Bureau of Publications, Teachers College).

The existence of such a variety of tests and scales (and there are many more) for a single subject such as arithmetic, although it may seem confusing to the beginner, is a great advantage in education. It enables the analysis of the difficulties that any class or individual may have. By using all or many of the different types of test it may be disclosed whether the achievements are uniform or whether certain operations or skills or abilities seem to require special attention. Such *diagnostic* analysis makes possible "remedial instruction" as distinguished from general teaching. In the field of reading these advantages are still more clearly to be seen.

Measurements of reading. Aside from the optical mechanics of exploring the printed page, which is itself very complex, the psychological factors in reading are of various kinds. Reading is so complete an example of mental activity, and the psychological processes involved in it so fully illustrate the activity of cue reduction, scope and joint activity of cues, that it constitutes one of the best examples of the learning process. Many experimental investigations have dealt with reading, and numerous tests and scales are available for the measurement of different parts of aspects of the act.

Reading as oral pronunciation. In oral reading all that need be implied is the delivery of the proper *names* for the verbal forms (printed words). The sound of the word, its phonogram, is the name of it. To read may mean merely to pronounce these phonograms. One might in this way read words in a language which had no meaning, just as one may read non-sense syllables such as *leb, dut, niv, feg*. The visual cues (words as seen) arouse the conventional articulation and phonation, and this is reading aloud. On a higher level than that of the pronunciation of single words, reading aloud also involves *expression,* and this requires appreciation of meaning and the joint operation of numerous context cues, such as accompanying words, punctuation, and other elements in the total situation. Both cue reduction and scope are thus involved in oral reading.

The Gray Oral Reading Test [28] is one of several designed to measure this aspect of reading. Standard paragraphs are presented and the pupil reads them aloud. The examiner records the rate and the various errors made. Suitable norms of performance enable the examiner to translate such scores into terms of excellence, and also to observe the characteristic difficulties experienced by the pupil in oral reading.

Visual word meaning. Another aspect of reading is measured by visual vocabulary tests, such as those of Thorndike.[29] Words are printed on the test blank, preceded by printed instructions. These instructions request the pupil to indicate the *kind of thing* of which the word is the name. Under all names of flowers he is to write *F*; so on, with *A* for animals, *G* for games, etc.

In its simplest form this process of indicating *word meaning* would be represented by proper names, the test being to point to the person or thing to which the name applies. On a higher level would be responding to common nouns by selecting, from an array of objects (or pictures of objects), the one indicated by the word. In the form we have described the process is so complex as to involve much more than reading. The *meaning* of the word must be apprehended, then the supra-ordinate class must be thought of, its name used, and indicated in the notation.

Reading for comprehension. On a still higher level of reading, the arrangement of words, their sequence, and various features of the context must be jointly responded to in an appropriate way. Thus "The dog bit the man" and "The man bit the dog" contain the same words, and the *word meanings* are the same. But the *sentence meanings* are totally different because of the word arrangement. The *total pattern* is here important, along with the *details* comprising it.

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[28] *Measuring the Work of the Public Schools,* Cleveland Foundation School Survey Report, pp. 263-275. Also the *Gray Oral Reading Check Test* (Public School Publishing Co.).

[29] E. L. Thorndike, *Directions for Using the Visual Vocabulary Scales* (Bureau of Publications, Teachers College).

Tests for this form of reading, for sentence or paragraph meaning, vary widely in character, depending on the nature of the meanings used, the character of the reaction required, and the degree of understanding called for. Human actions we have classified as those of thought, feeling and conduct. The various tests of *reading comprehension* make implicit use of such a distinction. The responses invited by the verbal cues may be:

(*a*) Imagined outcomes, results, symbols of later events, thoughts, choices, comparisons
(*b*) Appropriate feelings and emotions, as indicated by selection, verbal statement, facial expression, intonation and inflection in oral reading or reply
(*c*) Manual or other overt acts, such as making marks, executing various directions, performing acts in conformity with the instructions

Often all of these modes of reaction are involved in the same test. Thus if the child is requested to draw a line under the prettier of two faces, he must apprehend the meaning of pretty, the significance of the comparative form, get some mild esthetic feeling reaction to the two faces, and comply with the instructions to "draw a line."

Several tests for reading comprehension may be briefly described. The Thorndike-McCall Reading Scales[30] call for silent reading. The test consists in writing answers about the content of paragraphs, the instructions being "Read this and write the answers. Read it again if you need to." The paragraphs used increase in difficulty, and the measures are used to indicate "the ability of the pupil to use reading for a specific purpose"—*viz.*, the purpose of giving correct answers concerning the material just read.

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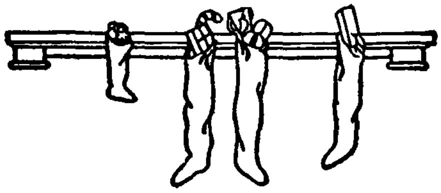
[30] *Thorndike-McCall Reading Scales* (Bureau of Publications, Teachers College).

A typical unit of the test is the following:

Inside the big box made of wood and iron that stands under the bed there is a box just like it, only smaller, and a brass key to open the small box. Whoever opens it will find three keys, one of gold, one of silver and one of steel. The first opens the door of the red room, the last opens the door of the blue room. The other opens the outside gate. Every key has a ring.

16. Where will you find the big box? ....
17. What is the chief difference between the boxes? ....
18. What will you find on each of the rings? ....

Another widely used scale for the measurement of silent reading is the Ayres-Burgess[31] series. Each scale presents twenty paragraphs of presumably equal difficulty of comprehension. Each paragraph is to be silently read with sufficient accuracy and understanding to enable the pupil to carry out the directions there given on a picture provided for each paragraph. Such a scale resembles the Courtis Arithmetic Tests in that rate, rather than difficulty or power, is the basis of the score. Distributions of scores for grades 3 to 8 are given on



12. The children will soon find the gifts Santa Claus left in their stockings. Since the littlest girl will wonder what is in hers, draw a hole as fast as you can in the foot of the littlest stocking so that she can peek in, but be careful not to make any in the toes of the three other stockings.

FIG. 36.—UNIT FROM THE AYRES-BURGESS SCALE.

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[31] M. A. Burgess, *The Measurement of Silent Reading* (Russell Sage Foundation).

each test sheet, so that the same test may be used for all these grades. Various equivalent forms are also provided. A sample unit of one of the forms is here given.

A useful set of tests for various aspects of reading is provided in the Gates series.[82] Preliminary study of the vocabulary appropriate to the various grades and of the more important processes involved in reading led to the devising of two series. In the three tests for the primary grades pictures or sets of pictures accompany the words, phrases or sentences. The pupils' marking of the pictures according to instructions given indicates the degree of correct recognition or understanding of the printed material accompanying them.

For higher grades (3 to 8) the Silent Reading Test is provided in four parts, which measure respectively the use of reading:

(*a*) In order to appreciate the general significance
(*b*) In order to predict the outcome of events
(*c*) In order to understand precise instructions
(*d*) In order to be able to report details

For (*a*) paragraph stories are given, with such printed instructions as:

Draw a line under the word which tells how the fairy felt,—
cross angry weary afraid joyful.

For (*b*) after a similar story, four alternative statements of "what will probably happen next" are given, one of which is to be marked. Thus, after a story about an encounter between a cat and a bulldog, the alternatives are:

They let the fight go on.
The cat slept on.
The lady took her bird away.
The groceryman saved his cat.

For (*c*) pictures accompanied by stories containing instructions to mark the pictures, similar to those of the Ayres-Burgess scale, are used.

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[82] A. I. Gates, *The Improvement of Reading* (Macmillan Co., 1927). The tests are supplied by Teachers College, Bureau of Publications.

For (*d*) material resembling that of the Thorndike-McCall tests is used, except that for each question four answers are given, one of which the child is to underline as the best.[33]

These samples, from two of the elementary school subjects, arithmetic and reading, serve to illustrate some of the ways in which modern education seeks to substitute objective records in the place of subjective impressions, and, while measuring, also to secure diagnostic indications of the type of difficulty the pupil meets with in the larger complex, called a school subject.

An understanding of the details and advantages of such scales must come from actual acquaintance with and use of them. For descriptions of similar scales and tests for other elementary subjects, and for secondary school, college and professional fields the references given at the end of the chapter may be consulted.

Omnibus tests of school achievement. For survey purposes and for the estimate of the general level of a pupil's achievement, various collections of tests have been devised, which are sometimes known as "batteries" of tests. The Stanford Achievement Test[34] is a well-known example. The booklet for grades 4 to 8 contains twenty pages and requires a little over two hours (several sittings are recommended) for its administration. The tests included are designed to measure the individual's proficiency, as compared with standard pupils of his status, in:

1. Reading
    - (*a*) paragraph meaning
    - (*b*) sentence meaning
    - (*c*) word meaning
2. Arithmetic
    - (*a*) Computation
    - (*b*) Reasoning
3. Nature study and science

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[33] Numerous additional tests and exercises for diagnosis and for remedial instructions are also provided. Details and illustrations may be found in Gates, *The Improvement of Reading.*

[34] G. M. Ruch and L. M. Terman, *Stanford Achievement Test* (World Book Co., 1926, and later revisions).

4. History and literature
5. Language usage
6. Spelling (dictation)

Various forms are provided, and grade equivalents and age norms, both for total score and for each separate test. This makes possible the analysis of the individual's special failings or excellencies, as well as the comparison of classes and schools, in each subject as well as in the general field of elementary instruction.

New type examinations. The movement toward objective tests, scales and examinations, with scores impersonally determined, the materials carefully standardized in advance, and norms of achievement based on results from large numbers of pupils, has had a far-reaching influence. It has encouraged the development of objective and "new type" examinations in nearly all the fields of academic instruction as well as in the work of vocational placement and industrial management.

Pupils are less likely now to be asked to write "essays" on topics chosen at random by the instructor, and rated according to whim or prejudice, on the basis of general impression. The more objective examinations, for one thing, eliminate many variables, such as speed of writing, penmanship, spelling, and eloquence, and may in this way restrict the rating more specifically to the matter in hand, to which all these variables may be irrelevant. Checking statements as true or false, choosing the best of several suggested answers, correcting errors in a proposition, supplying missing elements from a statement, may be the simple responses called for. Many more points may be touched on in a given time and a more complete inventory of the range of the pupil's knowledge secured.

Such examinations, if properly prepared, require considerable labor and insight. The time required for scoring may be reduced, but more time is required in the critical framing of the examination. Standardized examinations, with alternate or equivalent forms are sometimes prepared.

The variables in part eliminated in such content examinations may be independently measured, and confusion avoided. "Old-fashioned" examinations may be used to supplement the "new type" scales. In this way individual differences are better provided for and such factors as organization of material, coherence of presentation, discrimination and readiness of unaided recall of information do not go uncredited, in the final appraisal of the pupil's achievement or ability.

The new type, objectively rated examinations, with standard methods and comparative data from the work of other classes are still in the experimental stage in higher education. Their merit apparently varies with the field to which they are applied and with the insight with which they are developed, used and interpreted. The evidence at present suggests that such examinations afford greater reliability, with no loss of validity, and an economy of time and strain on the part of all concerned.[35]

In personnel selection and direction similar developments take the form of rating scales, standardized interviews, systematic trade tests, planned personal interviews and data sheets. They supplant, with wholesome results, the traditional reliance on photographs, self-estimates, letters of application, and testimonials, and weaken the confidence in more subjective methods of appraising human character and ability.[36]

For reasons partly historical, partly accidental, but chiefly because of interest and training, these various methods of mental and educational measurement have been to a great extent developed by clinical, applied, and educational psychology. Once placed on a reliable basis, their use rapidly spreads to the work of the teacher, the administrator and the educational expert.

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[35] A useful chapter and a bibliography on new type examinations is H. R. Douglass, *Modern Methods in High School Teaching* (Houghton Mifflin Co., 1926), Ch. xiv.

[36] H. L. Hollingworth, *Vocational Psychology and Character Analysis*, gives a survey of the development of methods of mental measurement in these fields.

Some practical considerations. The theoretical possibilities of "mental measurement" are so interesting that tests and scales have been widely used. They may be put to misleading uses and given erroneous interpretations by those not competent to understand and criticize them. It should not be necessary to emphasize the fact that the mere publication of a test and its designation as a scale by no means gives such an instrument either reliability or validity. Numerous considerations must be taken into account in the use of such techniques.

Thus the mere fact that one "intelligence test" correlates by a high figure with another accepted as standard does not mean that measures from the one may be accepted in place of measures from the other. If such measures as mental age result, scores from one test may be very different from those from the other, and yet different pupils stand in a similar rank or order by both. Everything depends therefore on whether one is interested only in relative rank, or in some individual description and evaluation, such as a mental age or an intelligence quotient would yield.

Similar dangers are present in subject matter tests and scales. A scale standardized on highly selected private school pupils is in a sense standardized, but only on this highly selected group. Applied to the ordinary run of school children, the "norms" would be very misleading.

Assigning a pupil a "mental age" of 11 years on a given performance means nothing if the performance be one in which ability as a function of age does not increase beyond the eleventh year; for to score 11 years would on such a test mean to make an "adult" record.

These are but samples of some of the more elementary sources of error which the use of tests and scales may involve. The classroom teacher, if intelligent and well informed, can make very good use of such instruments, in guiding and planning work, in tentative diagnosis of the pupil's difficulties, and in the analysis of the materials on which teaching is to be directed. The effort to introduce such objectivity and impartiality as the tests suggest may also be a useful gain. In matters concerned with the destiny and disposition of the individual pupil, mental measurement should be conducted and interpreted by those with expert competence in these methods.

PROBLEMS

1. Secure a pupil's examination paper in some subject and ask 10 different teachers to grade it independently. How do your results compare with those of Starch and Elliott?
2. Would it be possible to measure a person's "general health"?
3. Suppose you measure your pulse rate and find it to be 60 per minute. Does that mean anything? How can you tell what it means?
4. Find and demonstrate to the class some objective scale for measuring drawing, handwriting, sewing, lettering, composition.
5. Discover in detail the way in which this scale was constructed and what units it uses.
6. Take some group intelligence, such as Army Alpha, score your paper, and discover what the score means.
7. A young child (6 to 10 years) may be examined before the class with the Stanford Revision of the Binet Scale, in order to demonstrate the nature and use of this instrument.
8. Assemble such performance tests (non-verbal) as are available and get acquainted with their nature and use.
9. Give one or more of the Seashore musical tests to the class using the standard materials and technique and finding the individual scores and their distribution.
10. Bring to the class some scale or standard test in an elementary school subject and describe its nature, construction, validation, reliability and uses.

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CHAPTER XII

THE EDUCATION OF EXCEPTIONAL PUPILS

The psychology of special education. Special education is a term used to refer to provisions made for the instruction of pupils who differ in important ways from the average. Illustrations of such special or important deviations would be unusually bright or dull children; children with special talents, as in music or drawing; children with special disabilities, as in reading, writing or spelling; "problem" children, such as those with marked antisocial habits or great emotional instability; children with speech difficulties, such as stammering or stuttering; crippled children; and those suffering from serious impairment of the sense organs, such as deafness or blindness, or partial hearing and vision.

Above the level of the elementary school provision may also be made for deviating individuals. Colleges often make special provision for exceptionally able or interested students, as through Honors courses, greater freedom for elective courses, or from the usual requirements of class attendance. In adult education special provision is often made for those with language difficulties, due to the fact that the instruction is not given in their native tongue. Groups of illiterates are sometimes found who must, in industrial training, for example, be treated in a different way from that suitable for those able to read.

Psychology is able to make useful contributions to the work of special education. A psychological examination of the pupil, an inventory and measurement of his physical and mental equipment, a survey of his past history and of the methods used in his previous education will often throw light on the nature of his present difficulty. Such an examination may also suggest useful steps to take in the way of further instruction. It is often necessary to adapt the methods of instruction to the special handicaps, or to devise new methods which will reduce the burden of these handicaps. In this, also, psychology may often be of service.

Sensory and motor handicaps. The educational problems in the case of those wholly blind, or deaf, and in the case of those with physical deformities, are so special that no attempt will be made to discuss them in this general survey of educational psychology. Special teachers will usually be provided for such cases, and they will have been prepared for their work by particular instruction and experience.

Studies have been made of the educational difficulties met by pupils suffering from milder degrees of deafness or blindness. In a recent investigation[1] the hard of hearing children of a school population—those not deaf enough to be in an institution—were identified by instrumental tests (audiometric). They were paired with children from the same schools, with normal ability to hear, and of the same sex, race, age and parental occupational status. The two groups were given standard intelligence tests, and a study was also made of their school achievement and of the judgments as to their character, by the teachers.

As a group, the hard of hearing children were 6 points lower in intelligence quotient (Stanford-Binet) than those with normal hearing. There was, however, among individuals, no significant relation between intelligence and quality of hearing, and there was a great deal of "overlap" between the two groups.

When individuals of the same intelligence quotient were compared, no difference was found in school achievement, as shown by measurement with the aid of standard "achievement tests" and achievement in reading, spelling and arithmetic. Within the hard of hearing group there was little relation between degree of impairment and school achievement.

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[1] R. Madden, "The School Status of the Hard of Hearing Child," Contributions to Education, No. 499 (Teachers College, Columbia University, 1931). In this volume will also be found a convenient brief bibliography relating to deaf and hard of hearing children and their education.

The hard of hearing were never rated as leaders and were more often rated as shy and solitary. In ratings for such traits as obedience and general attitude no difference was found between the normal and the hard of hearing.

Bearing in mind that the more severe cases of deafness had been eliminated by institutional provision, that no measure was made of the effort required for the hard of hearing to make an achievement equal to that of their normal comrades, and the fact that this defect clearly led to less complete participation in social life and induced instead attitudes of avoidance and shyness, it seems clear enough that such cases could profit materially from special methods directed toward their adjustment.

Defects of speech. We may consider stammering and stuttering under this general head, although they are more likely to be psychological rather than sensory or motor difficulties. It is estimated that between 1 and 2 per cent of school children suffer from such speech difficulties, and they are among the most painful of personal handicaps. Often misunderstood by parents and teachers, and at the mercy of thoughtless playmates, the stuttering child suffers an emotional distress not usually realized by those who embarrass him. Since the nature of the difficulty varies greatly with the individual, the stuttering child should be referred as soon as possible to qualified clinical psychologists or to teachers with special training in this field.

This is no place for a detailed account of the psychology of speech defects,[2] but a brief account of one study may be given by way of showing the importance of allowing those with these handicaps to make the most advantage from the general program of the school, if only by better understanding them.

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[2] A chapter on this topic will be found in H. L. Hollingworth, *Abnormal Psychology* (Ronald Press, 1930).

In this survey[8] stuttering children in a city school system were paired with members of a "control" group, not so suffering, for age, mental age, sex, language, and racial background. The groups were then compared in various respects to discover whether the afflicted children showed any more general inferiority or disadvantage.

The distribution for intelligence was the same for the stuttering children as for a normal group. In non-verbal performance tests the stuttering children did even slightly better than the controls. In school achievement tests (Stanford Achievement Test) there was "no significant disparity between the two groups"—an important result in view of the obvious handicap of the stutterer in ordinary school recitation and communication. Various tests for emotional stability were also given, no significant differences being found. In the ratings by teachers for "personality traits" the two groups were again similar except in ratings for "self-confidence," where the control group was superior. Numerous physical tests were also given, and in these no difference was found between the two groups.

The stuttering child represents an acute case where special understanding, and perhaps special treatment and instruction, may be usefully applied, and where education may notably justify its claim to be an organized technique for the reduction of human misery.

The education of the dull. Reference to the curve of distribution for intelligence in the population, given on page 177, will show what a wide range of aptitude for learning and for literacy will be represented among pupils upon their first admission to school. Those with an intelligence quotient below 70, about 2 per cent of the whole, would be technically feebleminded. Many of these would have been placed in special institutions for the mentally defective; but not all. Pupils with intelligence quotients as low as 40 are by no means unknown in the elementary school.

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[8] E. D. McDowell, *Educational and Emotional Adjustments of Stuttering Children,* Contributions to Education, No. 314 (Teachers College, Columbia University, 1928).

Between this low group and the great number of "average" or "normal" children (the middle 50 per cent) stand a large group of border-line degrees of docility, with a low degree of ability for the mastery of symbols, and yet, as we have seen in Chapter VI, reasonably well endowed in physique. The ablest of these are likely to become the "laggards" and "repeaters" in the ordinary school grades. The less able will soon fall so far behind, because of their low capacity for learning, that in large communities special provision is made for them in "ungraded classes," "opportunity classes," and, at older ages, in elementary trade schools.

Under compulsory education laws, applying so late as the age of adolescence, these pupils either become serious problems of discipline, promotion, and concern, or else are provided for by some method of special education.

A clear understanding of the psychology of the unintellectual is necessary for their proper training. In the ordinary grades these pupils cause most of the problems of truancy, delinquency, and retardation. They will tend to be advanced beyond their level of ability, shoved ahead into grades for the work of which they are incompetent since no amount of "repeating" will enable them to maintain the normal pace at a later time. They may occupy an undue and wasteful proportion of the time of the teacher and class and thus retard the progress of those capable of advancing more rapidly.

The solution consists chiefly in the early identification of these unintellectual individuals, and their educational guidance into avenues where they can make the most of those capacities in which they are nearer the normal than they are in the arts of literacy. This may call for special curricula adapted to their needs, for their segregation in special classes or schools, and for greater emphasis on manual skills and the practical arts.

These pupils can be identified at an early age by technical measurement of their intelligence; they cannot be identified by their physical traits nor by the ordinary medical examination Standardized tests in which their capacity for learning, and the results of their previous learning under the conditions of a normal environment, are measured, are the most reliable means of identification. Such identification is possible with great reliability in the lower grades.

Educational possibilities. Many degrees of intelligence will be found among these pupils, ranging from very low to subaverage, and the teacher should never commit the error of supposing them to be "all alike." They will not constitute a separate "species," but only the lower end of the curve of distribution. They will not be equally feeble in all respects, as we have already seen in the chapter on the psychology of the learner. Some of their aptitudes will be nearly those of the average child. It may be psychologically wise for all pupils to work together in those activities in which their abilities are more nearly equal.

The mentally dull cannot be made "normal" by any method of treatment nor by any educational technique. Nor are they cases of "arrested development," who will in a few years show a remarkable spurt and come back to the normal level. The pace of individual development, except for very rare special instances, will be such as to keep them in the same relative position with respect to their fellows.

The methods of instruction need not be peculiar. The rate of learning and the nature of the material that can be mastered will vary, as we have already seen, with the "mental age" of the pupil, regardless of actual age. The chief exception to this rule is in the case of very *bright* children who may be physically only at age, and hence not capable of some of the physical feats of children of their own *mental* age, but greater actual age.

The things capable of being learned by individuals of various mental ages are shown by the following list of achievements found possible by *adults* of varying mental ages, in experiments in an institution for the care of the intellectually inferior.[4]

Mental Age	*Capacities for Learning*
2 to 3 years	Can be taught to carry pails of water and empty buckets; can carry *soiled* clothes to the laundry, but cannot be trusted to bring *clean* clothes in the other direction; can learn to collect trash, such as stones, leaves, twigs, from lawns and paths, and put it in baskets or piles.
4 to 5 years	Can learn to pull *one kind* of weed in the garden; can minister to pigs, rabbits and chickens but cannot learn to herd sheep or milk cows. Can, however, clean barns for such animals.
6 to 7 years	Can learn to garner *one kind* of fruit from garden or trees, not picking green or decayed, and omitting leaves, trash, grass, and not injuring the fruit. Can herd sheep, milk cows, and do the ordinary processes of the laundry, using blueing and soap: can do simple sewing.
8 years	Can learn to do everything in the laundry, can set the table and do most of the processes of cooking, but are not capable of learning to do general housework except under close direction and supervision. They are capable of acquiring third grade ability in reading, and of profiting from the elementary curriculum up to the end of the third grade.
10 years	This mental age is required before *adults* can learn to do general housework, and to arrange and properly time such acts. On this level they are capable of ministering to the simple domestic wants of human beings and running a house, but not of adequately controlling, advising or educat-

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[4] See M. Vanuxem, *The Education of Feeble-minded Women,* Contributions to Education, No. 174 (Teachers College, Columbia University, 1925); also E. T. Burr, "Minimal Intellectual Levels of Accomplishment in Industry," *Journal of Personnel Research,* Vol. 3, 1924, pp. 207-212.

> ing children, except under simple conditions and in things in which they are themselves competent. They are capable of fourth- or fifth-grade work in ordinary school subjects, can learn to read, write, do simple arithmetic, and may be able to make representative drawings and to play and enjoy simple musical instruments.

An example of the relative abilities of dull children in various school subjects is to be found in the result of careful examination of children in the special schools of the city of London.[5] Standard tests of achievement were given to these children, who had the average intelligence quotient of 57. On the basis of these results a figure was derived, based on the known laws of development, showing the mental age, in each of the various subjects, to be expected of these children by the time of leaving school at the age of 14 years.

School Subjects	*Mental Age to Be Attained on Leaving School at 14 years*
Reading for comprehension; composition; and spelling	6.8
Speed and accuracy of reading; subtraction; and division	7.5
Addition; multiplication; speed and quality of penmanship	8.3
Drawing; hand-work	9.4

The average achievement on leaving school would be eight years; but achievement would be far from equal in all subjects. Such children would be most nearly normal in drawing and hand work; in reading for meaning, in composition, and in spelling, the literate arts, involving reaction to symbols, such children would be even more backward than their average mental age would suggest. The reasons for these outcomes we have already considered in Chapter VI.

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[5] C. Burt, *Mental and Scholastic Tests* (London, King, 1922).

Aside from training in the simpler school skills, and such manual arts and skills as may best enable them to play a useful part in society and industry, something can be done for the unintellectual in the way of training in useful habits. Little can be expected in the way of understanding abstractions, applying general principles to specific cases, nor control of conduct by terms and ideals, such as those of "justice," "benevolence," and the like. Training in *specific habits* rather than in generalization is the effective rule for the mentally dull.

The reason for this should be apparent from the account of the general nature of learning. Mental dullness means the inability to establish acts or thoughts in connection with reduced cues. Therefore the dull do not react to new situations in terms of behavior earlier learned in connection with items or details that may now be present. Since little in the way of cue reduction can be expected, teaching will consist instead in the repeated presentation of *whole situations*, concrete experiences, such as those which the learner is to be prepared to meet. Fullness and vividness of original experience, concreteness rather than the use of symbols, will in this way make possible whatever degree of learning or cue reduction the learner is capable of, and will provide for him the maximum number of usable cues. In the lowest degrees of intelligence little in the way of training can be expected. Even on higher levels, much patience and understanding is required of the teacher.

The intellectually gifted. Above the average learning ability of the larger number of pupils there will stand a considerable number who are exceptionally able. A large group, with intelligence and learning quotients lying between 110 and 130 will distinguish themselves clearly enough from the average by their rate of progress, the small amount of time needed to master their assignments, the greater promptness and range of their knowledge. For the most part pupils of this degree of ability may be provided for in the ordinary school organization by rapid promotion, and by the provision of extra activities in which they are interested and from which they may profit.

Pupils with intelligence and learning quotients above 130 are as much superior to the average as the feeble-minded are below it. Certainly not over 2 per cent of the school population will be exceptional to this degree. But within this small number there will be a few whose quotients run as high as 180 or 190. Children of this degree of ability are likely also to present problems—acute personal problems of their own, and also problems of school management and organization.[6]

Such pupils are so much abler than the average members of the class that the usual program and range of projects fall far below their capacities for achievement. If kept in the regular class, selected roughly on an age basis, these children will have little to do; a few minutes serve them as well as an hour of study on the part of their companions. Hence they do not have an opportunity to attain the skill or knowledge of which they are capable. They easily, therefore, form habits of idleness, restlessness, and even of mischievousness. The ordinary work of the school easily becomes trivial to them, for when they return home they are likely to occupy their leisure in ambitious intellectual projects which mock the things the teacher has been expecting of them. They read the difficult encyclopedias, master strange languages, work out new solutions of mathematical problems, study and discuss international relations, or write original masterpieces.

Or if allowed to move rapidly through the lower grades, they soon come to be with children much older and larger than themselves. Although equal to these older pupils in understanding and intelligence, they cannot participate with them in the athletic and other physical activities on equal terms.

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[6] For a detailed account of the psychology and education of gifted children see L. S. Hollingworth, *Gifted Children, Their Nature and Nurture* (Macmillan Co., 1926). Also L. M. Terman and others, *Genetic Studies of Genius* (Stanford University Press, 1925).

They are unable to achieve the leadership and influence to which their ability would entitle them among children of their own age. Even among children of their own age they are not likely actually to be the leaders in all respects, since their ideas are so far in advance of those of their companions that they are not understood. Leaders, as is well known, should not be too much in advance of those led.

In the advanced grades to which such children might be promoted on the basis of their intellectual ability alone, their social relations tend to become peculiar. Physically, and in some respects emotionally, younger than the rest of the class, they may even become jokes to the older, larger and duller pupils. The education of the very bright child therefore becomes a problem of special education, which must be handled in terms of the psychology of such children.

Studies of gifted pupils. Exceptionally gifted pupils have always been in the schools. In earlier times the schools existed chiefly for the sake of the more able, and hence these pupils did not become outstanding educational problems. Their companions were more nearly their intellectual peers; they were able to assume responsibility, were given the stimulus of comparison with others of equal or nearly equal ability; they formed effective standards of accomplishment and good work habits. Their abilities, coupled with the education thus provided, enabled them to become the leaders in action, thought and invention. They achieved in later life the advances from which the population as a whole could derive profit.

But lowered educational standards, coupled with the increase in the school population as compulsory education became the rule for the masses, definitely interfered with this "natural selection" and training of the gifted. More and more it became necessary to recognize them as an educational problem, to identify them at an early age, and to consider ways of enabling the pupils themselves and society as a whole to make the most of their latent potentialities. This involved experimentation with various methods of special education for the gifted.

The first step was that of finding large numbers of such gifted learners in the school population, devising suitable "tests" for their identification, and studying their characteristics in other respects than that of capacity for learning.[7] It was found that such children usually come from families of unusual ability and attainment. Parents were not likely to recognize or appreciate the exceptional character of their children, who seemed to them to be "about average." But "average" meant for them "like the rest of the family," and this was really far from the average of the population. Such children were found to come largely from parents engaged in professional fields, or in the management of their own business, or in an executive capacity in trade and business. A very few cases were found whose parents were in the work of the "skilled trades"; occupational groups rating lower than this provided practically none of the bright children. Boys and girls were found in about equal number, although boys were more likely to be called to attention.

The judgment of teachers was found not to be very useful in the discovery of such pupils. Teachers tended to overlook the actual age differences; to pick as the "ablest" pupil in the class the one whose school tasks were best performed, neglecting the fact that this child might be older. School marks were found to be useful only when accumulated in many subjects and over several years, because of the well-known subjective character of such grades when objective tests are not used.

Objective tests of intelligence, of learning, and of school information and skill were needed to identify the bright, and the search for such pupils did much to stimulate the formulation of instruments of mental measurement. These had originally been used chiefly in identifying the dull, and therefore did not have to range far up in the scale of achievement or ability.

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[7] See, for example, Terman and others, *op. cit.* Several volumes of such studies have been issued by the Stanford University Press, since 1925.

When large numbers of such children, rating over 130 in intelligence quotient, were studied, the following general results were well established: [8]

Their heredity was superior, as shown by the occupation, the social status, education, health and longevity, and record of distinction of their parents and other relatives.

In physical and anthropometric measurements these children were larger and better developed than were "control" groups of similar age, sex and race. They were larger at birth; they walked at an earlier age; their general health was superior; the changes of puberty came earlier.

Educationally most of them were advanced beyond the average grade status for their ages, but not nearly so advanced as their ability would have justified. They uniformly had a genuine interest in learning and knowledge; half of them had learned to read before beginning school. Measured by objective, standardized tests of school achievement, they were far superior to the "norms." Various special talents, as in music, drawing, art, were frequently found.

These children were as balanced, in their abilities, as ordinary children; they were more interested in abstract than in manual activities, and in difficult than in easy subjects; outside school their intellectual interests were conspicuous; they made many "collections"; had many enthusiasms for scientific topics.

In play their interests tended to be non-competitive; they preferred games involving thinking, and playmates older than themselves. They were often regarded as "queer" by children of their own age, because of these more mature and solitary interests. They read widely with more inclination toward what was called "adult" subject matter.

In tests and ratings for various character and personality traits these able children were definitely superior to the control group. They were most superior in traits called "intellectual"; then, in order of decreasing superiority, the classifications came in the following order—"volitional," "emotional," "moral," "physical," "social." Finally, in "mechanical ingenuity" the control group was found to have its single superiority, a very slight one. We do not know to what degree this result depended on differences in interest and preoccupation.

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[8] The volumes, *Gifted Children,* and *Genetic Studies of Genius,* may be referred to for the details of these results.

Superstitions about gifted children. The popular superstitions that had been held concerning the intellectually gifted child were turned upside down by these results. The children were not "puny" specimens, feeble and sickly, as had sometimes been asserted. They were not destined for an early death. Instead the general law of the "quality of the organism" was again demonstrated. There was found a positive correlation of desirable traits, and these gifted children were superior, not only in intellect, but also, in varying degree, superior in all other respects.

The notion that such children were "nervous" and "unstable" emotionally was also dispelled. Objectively measured, or rated by the best methods available, they were on the whole less nervous and more stable than the average. Certain differences in interest, a somewhat greater fondness for solitary activity, and occasional emotional difficulties due to the maladjustment in which their very superiorities involved them were found. These appeared, when present, to be due to the treatment of such children by school and society, rather than to any intrinsic features of their make-up.

Follow-up studies of these children, in later years also showed that they did not "deteriorate" as they approached maturity, as popular superstition often maintained. Up to date these children have been followed through high school, many of them through college, and some of them into the later situations of marriage and practical life. Their record throughout, as a group, is outstanding and distinguished, fully justifying the earlier expectations of their achievement.

The notion that bright children deteriorate in later life is so widespread as to call for some comment here. In part, this notion is due to the fact that the public belief may be based on a few much "advertised" instances. In some cases these were really not very exceptional, but had only been specially trained for exhibition. In some cases of genuine ability, the very publicity may have turned their heads and deflected their energies from actual achievement.

But in the larger number of cases a much simpler explanation is to be given. A child with an intelligence quotient of 120 will in the lower grades achieve an excellent record, since most of his classmates will vary about a level of 100, and those with very exceptional ability are so few that none may be in this group at all. The child will, on this school level, have a record of "brilliance."

When such a child advances to the high school, the pupils will, on the whole, have been selected on the basis of their ability in the lower grades. His classmates will tend therefore to be of about his own degree of ability. He will be likely then to make an average record only; there is greater chance that really "exceptional" competition will be met with in this group of more highly selected pupils.

In college work a further selective effect will be met with. The average college student in good colleges has an intelligence quotient of about 130. But this average is higher than that of the pupil we have been describing. His performance now will not be distinguished; except for special effort and zeal, he will find himself among the poorer students.

The false impression may in this way be given that the ability of the pupil has gradually deteriorated, and that he is "going to pieces." Quite the contrary is the case. He is just the same pupil, with just the same ability. But he is being compared with standards that increase in their demands, and the farther he goes along the usual school route the more exacting do these standards and comparisons become. An understanding of the psychology of the pupil's classmates is as important for his educational guidance as is a knowledge of his own abilities.

Experimental education of the gifted. Since neither the "lock step" nor the methods of rapid promotion and advancement solve the problems of the gifted pupil, various experiments have been made by way of trying out one or other forms of adjustment. The possible adjustments might be enumerated as follows:

1. Maintaining the "lock step," keeping the child with those of his own age, whatever their abilities.
2. Rapid advancement, at rates varying with the capacity of individuals or groups, covering the usual curriculum, but more rapidly.
3. Keeping the bright out of the regular schools for a period of time, so as to allow others to "catch up."
4. Enriching the curriculum for the bright by allowing them to do additional things of the *same kind*, such as other languages, further reading, etc., but keeping the usual pace.
5. Keeping the usual pace, but enriching the activity of the bright by allowing more free play, physical exercise, or by the additional learning of some useful *trade skill*, as millinery, cabinet making, building, plumbing, farming.
6. Allowing a certain measure of rapid advancement, enriching the curriculum meanwhile by addition of other interesting activities, appreciations and interests—such as art, biography, travel, museum expeditions, history of industry, civic problems, etc.

What the most effective adjustments are to be is still a problem for experiment, and many such experimental ventures in providing for gifted children in the schools are being made. A brief summary of one of the most interesting will serve as an example.[9]

In 1922 two groups of bright children about 8 years old were selected from the various schools of the city and organized as special classes in one of the public schools. All were above 130 in intelligence quotient, the "lower group" averaging 146 and the "upper group" averaging 165. Over a three-year period, until they had finished the elementary grades, they remained in these special classes.

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[9] From a Summary Report on Pupils of Two Special Opportunity Classes of Very Bright Children, Authorized by the Board of Superintendents, New York City, September, 1922. See also L. S. Hollingworth, *Gifted Children;* and *Twenty-third Yearbook* of the National Society for the Study of Education, 1924, Part I, devoted to "The Education of Gifted Children."

Measurements of numerous kinds, mental and physical, including educational achievement tests, were applied and compared with various control groups—normal children, and also bright children not included in these special classes. Various kinds of curriculum enrichment were introduced, not provided for the usual grades. These included such features as conversational French, after school recreation, excursions, special study of biography, the history of civilization, and the study of algebra begun before the usual time.

Enrichment rather than rapid advancement was featured, although these pupils were already in advance of their age grade status, and some further rapid advancement was made. The standard achievements were required in the regular program of elementary instruction, but since less time than average was required for this, the remaining time was occupied by the various forms of enrichment.

A score or more of published papers[10] resulted from the study of the characteristics and progress of these groups, and the comparison of them with normal groups and with bright groups not entering upon the special enrichment program.

Achievement in subsequent career. Completing the grades, these pupils entered the various high schools of the city and were no longer grouped. But follow-up studies kept track of them, and the results were assembled at the end of the high school period.[11] Annual repetitions of various mental and physical measurements were also made, which threw valuable light on the progress of such exceptional children.

As a group they showed the usual superiority to a group of average children in all the traits we have considered in the foregoing accounts. They moreover maintained the superiority in these respects over the period of ten years through which they have now been followed.

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[10] The "Summary Report" referred to lists fourteen such studies to date of publication in 1929.

[11] See E. E. Lamson, *A Study of Young Gifted Children in Senior High School,* Contributions to Education, No. 424 (Teachers College, Columbia University, 1930).

Their high school records were distinguished, although they were on the average two years younger than a control group chosen scientifically from the high schools in which they worked. They received four times their "normally expected" scholarship honors; more than the normal expectation of "activities" honors, school offices, prizes, and the like. Intelligence tests showed them to be maintaining their initial superior status; in this respect they excelled the scores made by graduate students in a famous university. Most of them, at the end of high school, expressed satisfaction at having been admitted to the opportunity classes and to high school at the earlier than usual age.

What the most desirable plan may be for the education of gifted children is still subject to the results of experiment.[12] Certain particulars, however, may be clearly stated on the basis of experience at present:

1. Children 40 to 50 per cent in advance of their age in school achievement tests are usually not more than 14 per cent beyond their age grade status when no provision has been made for their special instruction.
2. In teaching the bright, *drill* may be very much reduced or even eliminated.
3. Artificial motivation is not required, provided that the subject matter be really suited to the intelligent interests of such children. Their native intellectual curiosity is keen and the scope of their interests broad.
4. Projects, as a method, are well suited to the bright; "socialized recitations" and joint enterprises on the pupil's own or partial responsibility, are well carried on.

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[12] Readers with particular interest in the modern methods and experiments in the education of the bright will find a useful reference to be the *Twenty-third Yearbook* of the National Society for the Study of Education (Public School Publishing Co., 1924). Part I of that *Yearbook* contains many reports and papers on the topic and an annotated bibliography of 453 references.

5. Management, control and discipline may be conducted on a plane of reasonableness and sound logic.

6. Particularly able teachers are required, who are themselves of high intelligence, well informed, acquainted with the psychology of the bright, and free from prejudice, jealousy and superstition.

The psychology of "homogeneous grouping." By "homogeneous grouping" is meant the plan of placing in the same class or group pupils of approximately equal ability. In a rough way this method is of course always used, even in the grade classifications of the usual school program. But actually the same "grade" is found to contain a wide array of individual abilities, as we have seen. In the special education of the deaf, the hard of hearing, and similar cases, homogeneous grouping is made on the basis of the particular handicap, rather than on the basis of ability.

Homogeneous grouping in the technical sense means the placing in single groups of pupils who have equal abilities as determined by objective measurement, by tests, and ratings. It has been argued that such a plan, whether in elementary, secondary or college teaching has many advantages. Arguments to the contrary have also been advanced. Experimental attempts to reach a decision have been made, and at present no final conclusion has been reached even on the basis of experiment.

The chief arguments in favor of homogeneous grouping are that it makes teaching easier, saves time, gives the duller pupils a taste of relative success, retains the less able pupils longer in school, prevents idleness among the able, and promotes coöperation, discussion and social consciousness.

Against the plan it has been argued that homogeneous grouping is unnatural and does not reflect the situation to be faced outside of school; that it is "undemocratic"; that it causes shame, discontent and feelings of inferiority among those placed in the slowly advancing groups; that snobbishness results in those given the higher ratings; that teachers in charge of groups recognized as "slow" do not sustain interest in the class; that the known fact of grouping tends to discourage actual individual attention, which is much needed even in groups homogeneous in ability; and that actual homogeneity in one respect (such as ability) does not mean homogeneity in other respects (such as zeal, health, family relations, etc.).

The experiments, of which there are now a considerable number[13] do not agree much more closely than do the arguments. Some have found homogeneous grouping better for the progress of the duller students; others find the opposite result. Some find it to be better for all groups, and some find no difference produced. At present, it seems safest to say only that homogeneous grouping of some degree is inevitable; that the degree to which it can usefully be carried and the best basis of classification, apparently vary with the circumstances; and that the effects, although variable according to circumstance, depend also on whether grouping is supposed itself to produce some miracle of teaching or whether this method is to be used only as an opportunity to introduce more effective methods of instruction and better adaptation of technique and subject matter to individual differences.

PROBLEMS

1. If "special education" classes exist in the schools to which you have access, visit one of them and report to the class.
2. What special provisions might any teacher make for pupils with partial hearing or vision?
3. Find a chapter or book on speech disorders and learn what various explanations of stuttering have been suggested.
4. Why have better provisions been made for the special education of the dull than for the bright? Do you think the practice justified?
5. Visit a home or training school for the feeble-minded and report to the class what educational methods and materials are used there.
6. Find in the literature the description of some special class

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[13] Useful discussions and a large annotated bibliography will be found in the *Twenty-fourth Yearbook* of the National Society for the Study of Education (Public School Publishing Co., 1925).

for gifted children and report to the class just what was done there.

7. Why do bright children so seldom come from occupational groups rating low in socio-economic status?

8. Can you find any evidence to show whether the distinguished people of history were exceptional as children?

9. If you were an intellectually gifted child what special opportunities or methods of education would you wish to have provided for you? Why?

10. Do you think this class in educational psychology should be sectioned into homogeneous groups on the basis of intelligence tests? Why?

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PART III

PSYCHOLOGY OF SCHOOL SUBJECTS

CHAPTER XIII

EDUCATION IN A SENSORIMOTOR SKILL—TYPING

The outstanding topics we have considered in this account of educational psychology up to the present chapter may be outlined as follows:

1. The learning process, involving cue reduction and scope
2. The teaching process, including selection of response, adoption of effective antecedent, inclusion of the cue to be finally effective, and rehearsal or drill
3. Motivation, and the general effect of an irritant in setting going an activity calculated to remove it
4. General and special conditions influencing the rate and permanence of learning
5. Special classroom procedures and techniques
6. Adjustment of education to the characteristics of the learner and the objective
7. Educational measurement, in the case of the learner and the school product
8. Educational and vocational guidance

It will be useful now to consider unitary projects in education, in which all of these, as well as various other psychological considerations play a part. This will amount to a study of the psychology of some of the particular "school subjects." We shall begin with a type of learning in which the activity is largely sensorimotor in character, that is, in which "thoughts" and "feelings" play a minor rôle, the prominent feature being motor activity controlled by sensory cues. Typewriting is such a sensorimotor dexterity; so also is handwriting; many acts of industrial skill, and even oral reading may degenerate into it.

A study of the learning and teaching of typing, to which much detailed study has been given, will serve to show some of the ways in which all the resources of educational psychology may be brought to bear upon a single project. If the emphasis given to this topic seems disproportionate, it should be remembered that it is simply chosen as an outstanding example of the way in which any sensorimotor skill may be studied. In the light of this analysis it will be instructive for the student to investigate other fields.

The sorrows of an unguided pupil. The advantages of a psychological analysis of typing, and of the processes involved in learning it, may be illustrated by the case of a man who learned to type at about the age of 30. He had no guidance, but simply began with pages of printed copy before him and transcribed these to the machine as best he could. There was, however, a strong motive to learn, and daily records of accomplishment were kept in terms of time and errors.

The process of getting a given word written was very complex. He had first to look at the copy, say a word or two to himself, look down at the keyboard, spell these words to himself, find each letter in turn by visual exploration of the keyboard, punch the appropriate keys, in the correct order, noting also the time to shift and to move the spacing bar. Three or four words at the most could be "carried in the mind" in this way and then it was necessary to look back at the copy, find the place, sometimes by referring again to the typed copy, take a few more words in memory and return again to the keyboard. No systematic use of the fingers was adopted, each key being punched from time to time by whatever finger of either hand seemed to be most readily available at the moment.

The process could be carried on in this way, and the page written acceptably, though very slowly. The process of producing a single typed element required so elaborate an antecedent or set of preceding stimuli that speed was impossible. This man continued for the next twenty years to perfect his typing, but used throughout the method by which he had begun. During that time he had typed, with accuracy, something over 25,000 pages of material, most of it from written or typed or printed copy.

Allowing 300 words to the page, this makes about 7,500,000 words written, or about 37,500,000 letters. Since there are but 26 letters in the alphabet, he had written each letter, on a rough average, about one and a half million times, each time locating it on the keyboard by direct or indirect vision.

At the end of this twenty years he was found, upon test, not to be able to locate a single letter on a diagram of the keyboard. In writing, it was still necessary to use his eyes in guiding the movements of his fingers for every single letter. When words were named, he was able to make various finger movements, showing a rough pattern, and indicating the general direction in which each of the letters would be found, or at least a considerable number of them. But he did not know upon which row of keys, nor upon just which key of any row a given letter would be found. Tested for copying printed material at this time, he was able to write but 25 words a minute, whereas champion typists are able to write as many as 150, and with fewer errors and much less strain.

A considerable amount of cue reduction had taken place, or these 25,000 pages could never have been written. It was now no longer necessary to look fixedly at each key. With the eyes fixed generally upon the keyboard, slight visual cues of indirect vision, guided also by the rather vague motor tendencies in one or other direction, enabled the writing to go on. But this unguided learner had never become able to dispense with visual guidance in his typing and still had to waver back and forth from the copy on his desk to the keyboard in front of him.

There could scarcely be found a more striking example of the value of scientific instruction, or of the futility of that fervent pedagogical maxim, "We learn by doing." We do of course learn by doing; but we do not thereby necessarily learn the thing we should learn, nor learn it in the way we should. We learn best with the aid of guidance and intelligent instruction, based on the observation of previous learners and the adequate analysis of the processes involved in learning.

What fundamental principles of education had been violated by this misguided typist? He had correctly discerned the *responses* that were to be achieved—punching certain keys in reaction to certain letters of the copy. But he had not singled out, to begin with, *the cues* which could most effectively be utilized in doing this in later writing. He had well enough found an *initial antecedent* or set of stimuli which enabled him at first to get the keys punched. But since no systematic use of the fingers was adopted, he had *not embedded in this antecedent* those motor and touch cues, from the hands themselves, which should have been adopted as the final guides to his movements. He had therefore never become able to *dispense with* the visual cues, which should have been freed at an early stage for complete attention to the copy and the general environment.

A preliminary analysis. Our exposition of the learning of typing will be based on experimental observations[1] of such learning, which the reader may find described in greater detail in the literature of educational psychology. Other material bearing on the topic may be found in the various manuals of instruction written by teachers of typing. Writing by the "touch method" will be used for our illustration, but similar studies of learning by the visual method will be found in the references and show the same general principles to be involved.

In beginning to teach the typist, it is realized that ultimately the eyes should not be occupied with the machine. They should be free for noting the copy and for the general orientation of the typist in the environment. The keyboard may therefore be covered. Unless the arrangement of the keys has been memorized by previous learning from a diagram, or from the visual examination of the keyboard, a diagram of the keyboard may be placed in the field of view, close to the copy to be written.

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[1] W. F. Book, *The Psychology of Skill,* 2nd edition (Gregg Publishing Co., 1925); E. R. Hoke, "The Improvement in Speed and Accuracy in Typewriting," Johns Hopkins Studies in Education, No. 7, 1922; F. L. Wells, "Psychomotor Mechanisms in Typewriting," *American Journal of Psychology,* Vol. 27, 1916.

A standard position at the machine is assumed, which has by previous experience been found to be a useful one. The height of the chair, the distance from the machine, the position of the hands and fingers are determined. The two hands are placed on the keyboard with the little finger of each placed on the end keys of the middle row of letter keys. These "anchor" keys serve to keep the position fixed and make it possible to use all the fingers of both hands, and certain fingers for certain keys. A line on the diagram of the keyboard may also serve to determine which hand is to be used in case of keys near the middle of the rows.

The necessary steps, in the beginning, are therefore somewhat as follows:

(*a*) Reading the copy, pronouncing it in internal speech so as to "bear it in mind" for a moment
(*b*) Spelling the words, so as to reduce them to their letter constituents
(*c*) Finding each letter on the keyboard diagram by looking, while bearing in mind the copy and the spelling
(*d*) Finding the proper key on the hidden board, by feeling with the fingers for the right row and then counting in from the end to find the particular key
(*e*) Getting the proper finger on this key, the finger that is thereafter to be "dedicated" to this key
(*f*) Again pronouncing the letter or thinking it in connection with this position and finger
(*g*) Making the final punching movement that writes the letter
(*h*) Recovering position, and getting a new bit of copy or finding the next letter on the diagram of the keyboard

In addition to this main process of moving the keys, many other things have to be learned. The machine in general has to be manipulated, the space bar has to be touched at the end of each word, the carriage has to be shifted at the end of each line, margins have to be observed, paragraphing has to be noted, paper has to be fed and removed, and so on. All these must be learned, and in just the same fashion, by reduction of the cues originally required for them. To simplify our analysis we shall limit it for the most part to the one process of using the writing keys.

First step in cue reduction. In the cases observed, one of the first acts to drop out was the spelling of the words, used in the beginning to direct the locating of the keys.

> The learners unconsciously began to keep their eyes focussed more and more on the copy because of the difficulty occasioned by holding the copy in memory. The spelling became more and more incipient and fugitive until the mere sight of the letter . . . set off at once all the processes.[2]

At moments of difficulty this spelling cue is brought into play again. When the copy for one pupil was accidentally covered "he found himself actually spelling out the rest of the word he was writing." Another reports, "When I get lost on the keyboard . . . the tendency to spell (vocalize) the letters . . . is noticeably stronger." Also, "Any attempt to write from remembered copy at once brought in an actual or incipient spelling."

This process has sometimes been described as "short-circuiting"; it has also been called "fusion of the first and second step." Of course, both "short circuiting" and "fusion" are figures of speech. The simplest statement would seem to be that "spelling" comes to be dispensed with because the earlier item, *seeing the letter*, comes to be as effective as both of them originally were. That is to say, cue reduction is occurring.

The second step in cue reduction. A similar elimination ot once necessary stimuli occurs very early. The process of locating the key on the board becomes "condensed." Instead of first finding the letter on the diagram, then fumbling or feeling with the fingers to locate this point on the keyboard before the key is punched, the "visual image of the location" or a

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[2] Book, *op. cit.*, p. 32.

"movement of attention" toward the location begins to appear without the fumbling. The "movement of attention" is apparently a certain motor adjustment of eyes and fingers toward a certain direction, which had formerly required, for its production, first the observation of the diagram and the feeling with the fingers among and along the rows of keys. Now this "orientation" also comes to follow immediately upon the initial sight of the letter in the copy.

> I have still a general visual image of the keyboard but (after 5 days of practice) the keys are now located by making use of a sort of visual-motor image that tells me more readily and surely the direction and distance of the keys desired.[3]
>
> X, at about the same stage of advancement, described at length how the movement of attention to the exact position of each key came to follow always more naturally and easily upon the sight or spelling of the letters, and the movements necessary for getting the proper fingers to the keys more closely upon this movement of attention.[4]

Reference to our list of steps necessary in the beginning shows now that steps *b*, *c*, and *d*, have come to be unnecessary, since step *e* comes to follow so definitely and readily upon step *a* that the initial *irritant* that formerly led to them is removed before they happen.

Further abbreviations. The next stage is described by Book [5] as "abbreviating the methods of getting the right finger to the proper key," and reference is made to "the rise of the motor-tactual image." This "motor-tactual image" was given effectiveness by "eliminating the steps used in building it up" and by "discarding the intermediate steps used as guides" up to this time. Using this motor-tactual cue is "getting the right *feel* for the separate letter-making movements, or learning to attend to the motor-tactual image of the movements and making it guide the fingers."

Let us consider briefly in what this process of "elimination" consists, for it is a further step in cue reduction, as the observers themselves recognized. At first, the right key was found by feeling about with the fingers, imaging visually the positions, feeling the little fingers maintained on the "anchor keys," feeling the stretch and direction when the proper key had been reached, feeling the position of the hand just before that movement, and the relation of these various movements to one another.

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[3] *Ibid.*, p. 35. [4] *Ibid.* [5] *Ibid.*

Numerous observations are recorded of various devices resorted to in this process which is very complex. It was observed that after striking an "i" a certain movement led to an "o" and a certain other movement to the final "n" of a word like "nation." Letters came to be located not only with reference to the "anchor keys" but also with reference to one another, and, with fixed starting points, definite movements and stretchings were recognized and relied on as guides to given letters. *All these were used as rapidly as they were* "discovered," although of course such feelings had always been present.

In this way a spatial location and a motor adjustment and cue for each letter came to suffice, without the necessity of always counting forward from the anchor keys. Soon the sight of a letter in the copy aroused directly this "tactual-motor image" or "feel," and since this had previously led to the punching of the key, it did so now unaided.

> As direct letter associations developed, these devices were all slowly discarded, the one direct movement being more economical than any improvement of the earlier detailed method. The tendency to use this better method and to strike for a letter directly instead of locating it by the older and (for a time) surer way, was very strong. . . .
>
> As time passed the learners came to rely with more and more justifiable confidence on the motor-tactual image of the direct letter-making movements for guidance and became less and less conscious of the keys which lay between their little fingers and the keys to be struck.[6]

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[6] *Ibid.*, p. 37.

So strong was this tendency to cue reduction in the production of key striking movements that the learners often found themselves running ahead of their ability; movements that were *approximately* correct were touched off, without the *control* of the other cues available, and error resulted. For a time, in other words, cue reduction had to be restrained by the joint operation of various cues, without the synergy of which accuracy suffered.

Reduction of tactual-motor imagery. In the course of further practice the full strength and completeness of even this abbreviated cue is dispensed with; the details of the "feel" are no longer heeded, and very general aspects or features of them become adequate, so far, at least, as conscious attention to them is concerned.

> The motor-tactual image is needed as a guide for the movements for a short time only, and having served that purpose it soon drops out of consciousness altogether and only reappears when a mistake is made or when for any cause the learner drops down to a lower plane of writing.[7]

Of course, even at this stage, and throughout, for that matter, actual tactual and motor sensitiveness in the hands is required. If the hands were completely anesthetized the writing would be impossible. What has happened is that this cue, up to this time an important part of the stimulus required for the actual initiation of the movement, is no longer needed. The mere sight of the letter in the copy now leads effectively to the appropriate movement. But the process of elimination is gradual.

> At first the movement must be carefully attended to throughout its whole course. As practice continues its motor-tactual image comes to be attended to more and more *generally;* as the individual movement becomes fused with other letter-writing movements in writing words, less and less attention needs to be given to its "feel." But some conscious guidance is required for months after it can be almost automatically made. . . . The complete direction of these

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[7] *Ibid.,* p. 41.

movements was turned over to the fingers *very gradually,* and conscious direction dropped out too gradually to be accurately described.[8]

Perfection of the letter-writing stage. As it comes about that the mere sight of a letter in the copy is an adequate cue to the production of the movement that is appropriate, the learner reaches a level of performance which we have described (in Chapter VIII) as a "knowledge" level. Any word can now be written, regardless of its meaning. Words may be written backward; long words are not harder than short ones. There is no spelling, no groping with fingers, no consultation with the keyboard diagram, no motor-tactual imagery. With the learner's eyes fixed on the copy the separate and successive letters are transcribed.

If attention at this stage be not firmly directed to the task, and if motivation to improve is not present, a *plateau* may occur, on which no further progress appears to be made. But if attention is kept on the task and effort continues, and irritation is felt at the slow rate of writing, it will be discovered that a still further reduction of cues is possible, which will result in greater efficiency and greater ease of performance. This stage has been described as a "critical stage," and it may be seen in the accompanying graphs of the course of practice in the case of the learners from whose experience we have taken these observations.

The new step consists in the development of what have been called "higher order" habits, in which syllables, words, or phrases come to be the units of performance, rather than single letters. We must now inquire how this takes place.

Cue reduction in higher order habits. By the time the single letter writing has become perfected, the process is kept slowed down by the act of reading the letters one by one. Since reading has already been well developed, the next thing that happens is that words instead of letters are read from the copy. This necessitates the reëntry of *spelling,* which was also important on the lower level of learning in its initial stages.

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[8] *Ibid.,* p. 39.

First, short words, and common syllables and letter combinations come to be noted in the copy and thought of as units. All the constituent letters thus being in mind, and in the correct order, the movements appropriate to them tend to be aroused in order and tentatively in advance of their actual execution. Overlapping of performance comes to be possible. The writing of one letter is not a single isolated act but becomes a step on the way to the next movement, into which it also leads.

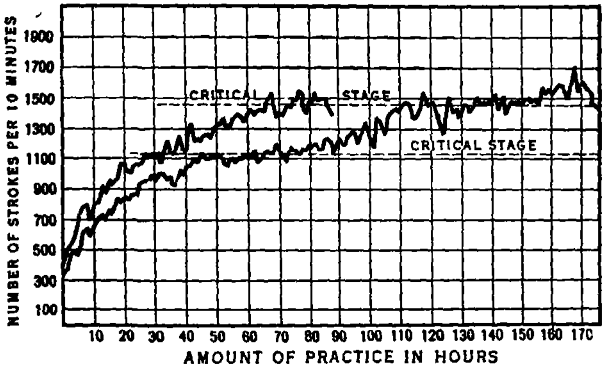

FIG. 37.—IMPROVEMENT IN TYPEWRITING. (After Book.)

This *spelling* now comes to be abbreviated. Instead of a full enunciation of all the letters, it becomes, as time goes on:

> More and more incipient, and soon links itself closely with the process of locating the keys and yields to a characteristic pronunciation of the syllable or word as a whole. . . . At first it meant a hurried anticipatory following of the whole course of the movements to be made both as to direction and succession—a sort of *group* spelling taking the place of the old detailed thought of each letter. . . . Later . . . a higher form of this group spelling, where less and less attention had to be given to this succession of individual movements, became slowly operative.[9]

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[9] *Ibid.*, p. 48.

As this larger copy unit comes to be the cue, the orientation on the keyboard changes accordingly. "I seem to feel beforehand in what direction the following movements are to be made and seem further to have a vague motor knowledge of the positions of all the keys."

As this continues, the learner ceases to be aware of the individual movements, unless they go wrong. Instead, he is aware of certain patterns or "areas" which come to run themselves off as units. The presence of all the letters in their proper sequence in the copy, after group spelling lapses, serves as the pattern cue to this organization. In time the feeling of preceding movements, in writing one letter of a word, comes to be a further cue for the guidance of the next movement, even when the eyes are removed from the copy.

In general, much the same course of abbreviation and cue reduction is described in the case of these word and phrase habits that was cited for the writing of individual letters. The development is made possible essentially because the cues of letters seen in advance of those now written, or the thought of letters spelled in advance of those now being made, although these are very slight and subtle cues, are adequate to set going the movements that are shortly to be called for by them when they more fully appear in the copy or in the mental spelling.

In the expert stage, which supervenes upon this if effort is continued, all the mental spelling drops out; the group awareness of movements and "areas" falls away. The mere sight of the patterned material in the copy, with its arrangements of words, sentences, paragraphs, keeps going the movements in a continuous flow, without any intervening stimulation being needed. There is no spelling, no motor-tactual imagery, no groping with the fingers, no consultation of the key, and even the meaning of the material may not be apprehended. Only when things go wrong do some of these original aids come to the rescue, aroused by the initial stimulus since the terminal act toward which it normally leads does not occur

The process is by no means so simple as our outline has sug gested, and the stages do not follow one another with the clearness the description suggests. There is much overlapping and frequent relapse. Some word units may be mastered before all the separate letter locations are automatized, and the actual process required varies with the difficulty of the material, with the speed attempted, the condition of the learner, and many other variables.

But the general outline conforms clearly enough to our analysis of learning as cue reduction. The terminal act at the finish is just what it was in the beginning, punching keys in serial order. The intermediate processes which have now been eliminated were not "random responses." They are better understood as "necessary stimuli" to the acts which followed them, in spite of the fact that they are also responses to the acts that went before them. But it is in their capacity as stimuli, not in their rôle as responses, that they are eliminated.

Details of perfection. The expert typist prides himself not only on the accuracy and speed with which he can transcribe dictation, stenographic notes, print or manuscript, or write spontaneously from his own thought. Various qualitative features of the typing are also important. The strokes should be made with equal force so that the typed letters will appear with equal clearness. The spacing and timing of strokes should also be accurate so that the spacing of the letters on the page will be uniform.

Beginners often have difficulties with these things. Keys are struck at varying tempos and intensities or not in keeping with the movements of the carriage. It is interesting to note the methods that practical teachers of typing have resorted to in order to promote better quality in the writing. Complex antecedents and stimuli are first introduced which will facilitate uniformity of force and time in making the strokes. A favorite material for such guidance is the phonograph rhythm record, which sets the pace. These sounds, along with the visual cues of the copy, thus coöperate in determining the movements. In time these guiding cues (the rhythmic sounds or guides) may be dispensed with and the sounds and movements of the learner's own activity may take their place. That is to say, in these details of finish the recognized method is once more that of first finding a context or antecedent that will produce the desired order and uniformity, then gradually dispensing with these stimuli as other collateral cues become singly capable of steering the process.

The learning curve for typing. The graphs of Figure 37 are given by Book to represent the course of learning in the case of two of his experimental subjects. The general shape of the curves will be recognized to conform to our general description of such curves. There is the rather rapid advance in the beginning, the improvement, as measured in the same units, becoming less and less as time goes on.

Irregularities from day to day as shown here are typical for all kinds of learning. These curves show rather definite plateaus or critical stages, although some such curves do not have them. Some have supposed that these plateaus represent necessary levels of unimprovement, while lower order habits are being perfected and before higher order habits are ready to be relied on.

Book believes that in typing this is not the case, and that the plateaus are avoidable. No actual improvement in lower order habits was shown during the plateaus. Lapses of attention, faulty efforts to press ahead with methods not yet fully understood, loss of zeal and interest, and similar factors should always be looked for first in such cases. Some learners of typing show no plateaus at all, so that it cannot be said that these are necessary periods. It is however true that such periods are critical, since in them faulty habits and attitudes of discouragement may arise.

The work curve for typewriting. It will later be shown that a preliminary warming up or relearning is required in typing at a given sitting before maximum proficiency is reached, or even before the best efficiency of the preceding day. Typists who write continuously for several hours at a stretch show a characteristic curve of work, the rate and accuracy varying somewhat from hour to hour. This does not mean that a certain "time of day" is better for typing than other times, considered merely as times. Instead, it is apparently the effect of preceding general activity that is responsible for the effect.

In general, the speed of typing increases gradually up to the middle of the day and then declines. In the following graph curves of work are shown for several varieties of mental test activities, for workers beginning at 10 A.M. and working until 10 P.M. The beginning trial is called 100 and the values of subsequent trials stated in terms of this as a base, for each test. For all but typing the results are the averages of ten workers on two different days. The typing curve is that of a single worker who alone worked at this process.

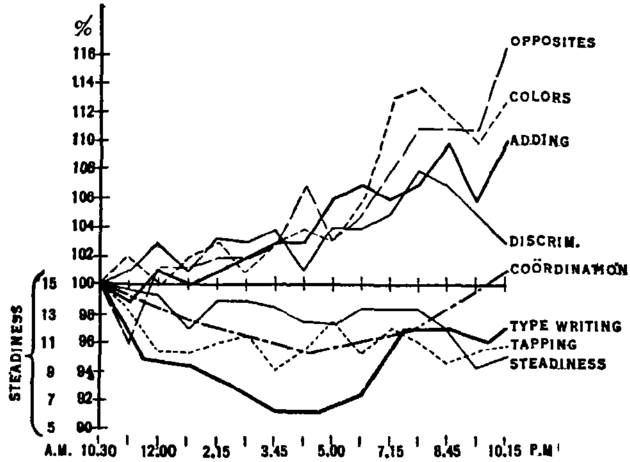

FIG. 38.—SHOWING THE EFFECT OF CONTINUED WORK ON THE DIFFERENT TESTS.

Each record is the average of 20 determinations, 10 observers, 2 days each. Records are given in *per cent* of initial performance, except in the case of *steadiness*, where the number of contacts is given.

The lower these curves the less the time taken for a given amount of work. It is seen that different kinds of activity show different courses throughout the day, and this is an interesting fact about different kinds of work. Thus in steadiness and in rate of tapping, the records become better and better as the day's work proceeds. In most of the "verbal" and "associative" tests the result is quite the opposite; the work becomes less and less proficient the longer it is continued, always at the maximum possible speed and accuracy.

Typing, and also coördination, which is a target hitting test similar in some respects to the work of typing, give a very different curve still. The point of maximum efficiency is in the middle of the day's work. This high point is reached by a steady improvement from the early morning trials. Beyond this midday period, relative inefficiency begins to set in, and the records later in the day resemble those at earlier hours.

Wells[10] also found an improvement in efficiency of typing from morning to noon and remarks that the gain "does not appear to be dependent on the doing of typewriting in the meantime." We shall later report Book's observation that improvement was most likely to be hit upon when the work was going well and the worker felt efficient. It might follow from such results that early and late hours of the day would be less effective times for practice exercises in typing.

Incidental influences affecting typing. Observation of the experimental learners revealed a number of significant factors as contributing toward their progress or retardation.

1. A calm attitude was most favorable. Being upset, even by such trivial things as a few hard words, having to change a ribbon, or unpleasant thoughts about one's progress materially diminished the score for the time or even for the whole day.
2. Preliminary relearning is often needed. Upon beginning work for the day it was found that one could not ordinarily take full advantage of what he had learned in the preceding day. A certain period of warming up or relearning was found necessary before the original level was reached.
3. Irregularity and fluctuation in rate of progress were the rule. Numerous sources of such variation, quite beyond the control or

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[10] F. L. Wells, "On the Psychomotor Mechanisms of Typewriting," *American Journal of Psychology,* January, 1916.

explanation of the learner, had to be recognized. The learners often showed the ease with which low level of attention and effort might become fixed as a habit, to the detriment of further rapid gain.

4. The critical stages call for special attention. The learner does not know the reasons for his failure to improve. With no guidance, even strong and persistent effort at such periods may go wrong, and result in waste of energy or even in the fixation of wrong habits, resorted to in ignorance of the source of the trouble.

5. Improvement was most likely to come when the learner felt in good form and when the work went particularly well. This may of course also mean that when improvement is taking place and the work therefore going well, the learner will report such a good state as his condition.

6. The importance of the irritant as a motive was particularly well shown. "Dissatisfaction with his score makes a learner vary his responses indefinitely or until a new and more advantageous method of response is acquired."

7. Emphasis on speed at the expense of accuracy was a disadvantage in early stages where speed was unjustified. On later levels striving for speed, with accuracy, was a useful attitude for improvement.

An extraneous influence measured. The causes of the variations from trial to trial are varied; some lie in the motivation, the methods, and other mental features of the learner. Others are due to changes in his system, such as fluctuations in health and vigor. Definite measurement and demonstration of such influences is easier when the factor is experimentally applied and controlled. An illustration in the case of typing may be found in the effect of caffeine, the active ingredient of coffee, tea, chocolate, and certain soda fountain drinks.

The following graph will serve a double purpose. It shows the time required to copy a definite amount of printed material of uniform character on the typewriter by a typist who was already proficient by the touch method when the experiment began. She was specially motivated by the desire to improve and worked steadily at this copying throughout the day for four weeks. She wrote three pages at a sitting, seven times each day. The curve, in terms of time, shows the time required to write all the day's work after the first sitting each day, that is, the time for eighteen pages of copying.

It will be seen that even this experienced typist shows a definite practice curve from the beginning, reducing the time required notably as the result of the four weeks of motivated work. It would appear that she had been working on a plateau of proficiency until this occasion.

The graph shows two curves. After the first sitting of each day the typist was given a capsule containing, on some days, an inert substance, sugar of milk. On the remaining days the capsule contained caffeine, the dose increasing from 1 grain in the beginning to 6 grains at the end of the four weeks. The dotted or broken line shows the course of practice on the control days after taking the inert capsule. The solid line shows the course of practice on the drug days.

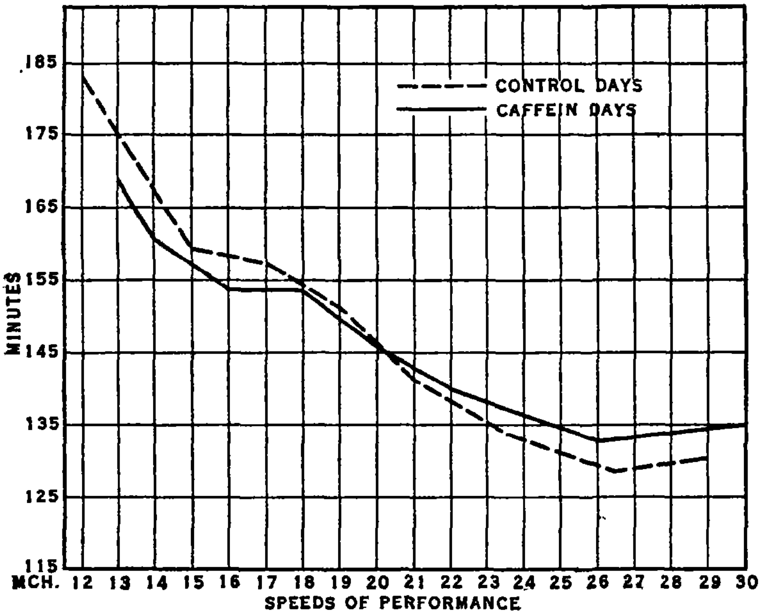

FIG. 39.—INFLUENCE OF CAFFEINE ON TYPEWRITING.

Up to the 3-grain dose, at about the middle of the experiment the typist works uniformly faster on drug days. When the dose exceeds 3 grains, beyond the middle of the experiment, she works uniformly faster on control days. Small doses of this substance (caffeine) apparently stimulate the performance, and the stimulation does not result in greater inaccuracy. In fact the total number of errors, both corrected and uncorrected, was less throughout on the drug days, even with the larger doses.

Large doses of the drug (that is, 4 to 6 grains, about the amount contained in two cups of strong coffee) produce a slower performance and retard the rate at which the improvement occurs. Small doses stimulate learning, larger doses retard it. The results are given here merely to show how definitely specific factors in the situation may be shown to influence the rate of learning.

Vocational guidance and typing. In order to determine beforehand whether or not a given pupil would be likely to become proficient if he undertook the study of typewriting, other tests than ability to type would need to be used. These tests would need to be such as would distinguish between different degrees of ability to *learn* typing. Studies of this kind have been made, and one of them[11] will be described as an indication of the use of prognostic tests.

A group of students, upon beginning their study of typing, were given various mental tests, chosen more or less at random, but with some attention to their *a priori* possibilities as related to such activities. Each month thereafter, as the training in typing proceeded, typing tests were given which gave a measure of ability and progress at the time.

Each month the results of the typing tests were correlated with the scores in the initial mental tests, given before beginning the training. Comparison was stated as a figure of correlation, which might, if positive, range from 0 to 1.00. The higher the figure, the closer the correspondence between ability in the mental tests and ability to progress in typing.

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[11] H. W. Rogers, "Some Empirical Tests in Vocational Selection," *Archives of Psychology*, No. 49, 1922.

The following table of correlations resulted from comparisons in four months.

Test	October	November	December	April
Verb-object	.41	.43	.46	.57
Color-naming	.30	.43	.45	.61
Checking numbers	.45	.47	.37	.30
Action-agent	.42	.43	.29	.40
Substitution	.21	.27	.11	.42
Agent-action	.29	.19	.40	.28
Directions	.11	.14	.19	.32
Naming opposites	.17	.11	.07	.54
Analogies	.09	.21	.17	.00

The first four of these tests show reasonably high positive correlations with typing ability in all of the months. Those acquainted with the statistical properties of such coefficients will be aware of the unreliability of any one such coefficient when it is so low as these and when the number of cases is small. But the evidence seems clear that some tests are better able to predict *in advance* the relative ability of different novices to learn typing.

The first four tests on the list, when combined into a team or battery, and given due statistical weight, were found to correlate with achievement in typing by a coefficient of +.61, which is a higher and more dependable value. It is not, however, sufficiently high or reliable to serve as the basis of prediction or guidance of individuals, however useful it might be to an employer who wishes merely to select the better material as prospective students of typing.

After a statistical analysis of the meaning and reliability of such coefficients, Rogers concludes as follows: [12]

> We can predict that individual A who scores 140 in the psychological tests will most probably attain an ultimate ability in typing of forty words per minute, and in 99.7 per cent of the cases she

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[12] *Ibid.,* pp. 37-38.

will attain an ultimate ability in typing varying between 31 and 49 words per minute.

Individual B, who scores 96 in the psychological tests, will probably attain an ultimate ability in typing of 32 words per minute and in 99.7 per cent of such cases she will attain an ultimate ability in typing varying not more than between 23 to 41 words per minute.

But it can readily be seen that these predictions are of very little practical value for the individual, in that they afford her very little definite information about just what ultimate ability she, individually, will attain.

The correlations are not high enough and the scatter value is not small enough to warrant the establishment of a system of vocational guidance whereby an individual can be advised, with any sufficient degree of safety, to undertake or not to undertake to prepare herself to become a typist.

These conclusions as given apply to typing alone, but much the same thing must be said, for the present, of all attempts to guide individuals vocationally by means of prognostic tests administered with any dictatorial authority. Such information as the preliminary tests here yielded, and the *probabilities* of success in typing which they indicate, would be instructive information to place in the hands of the intending pupil or his teacher. But for the most part such materials at present illustrate an interesting field for future educational investigation, rather than a closed set of techniques.

Studies of the typewriting curriculum. Corresponding to the study of curriculum and arrangement in the case of other fields would be the analysis of the demands on the typist, the frequency of different letters as used in typing, the common sorts of error, the suitability of the keyboard, and similar considerations. Various studies of this curricular sort have been made.

Hoke [13] counted the frequency of each letter of the alphabet in the one thousand words of the Ayres spelling scale, in a section of the Bible, in business letters, and editorials. The results were as shown in the accompanying graph, and they accord quite well also with the number of times each letter is provided in standard fonts of printers' type.

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[13] E. R. Hoke, *Improvement of Speed and Accuracy in Typewriting*, Studies in Education, No. 7, Johns Hopkins University, 1922.

E is the most used letter of all, and six letters, E, T, A, O, S and I are used as often as all the remaining twenty letters of the alphabet. Of these six letters, four are vowels. This shows the relative frequency with which the letter will be needed, and also the frequency with which it will be practiced in copying the ordinary run of copy.

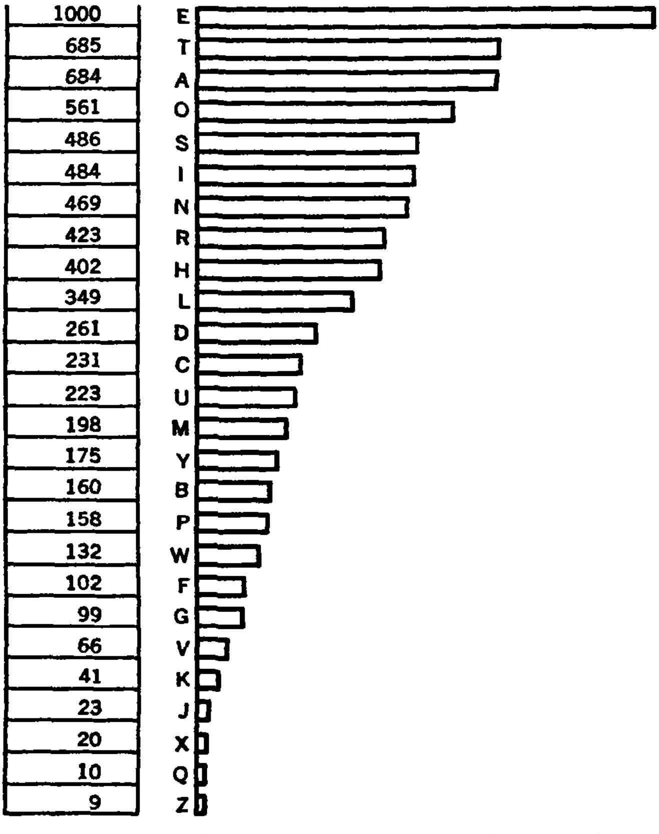


Fig. 40.—Relative Frequency of Letters Used in Typing. (Adapted from Hoke, *op. cit.*, p. 18.)

Attempts to apply such an analysis of frequency of use to the planning of instruction in typing encounter all the difficulties we shall consider in our chapter on the curriculum. The argument that the letters most needed should receive the most drill might be met by the counter argument, based on the frequency of errors, that the letters *least* used should instead receive the emphasis. Hoke showed, from an analysis of five hundred pages of typing by one hundred different individuals that "a very close relation between use and accuracy" exists. The correlation between frequency of use and number of errors for the various letters was over .92.

This also raises again the issue whether the school should in its curriculum seek simply to present actual life situations. Certainly the direct copying of regular printed materials in typing would give the learner practice in the various letters in proportion to the frequency of their practical use, and this would appear to be superior to the use of formal drills on materials abstracted from their context.

On the other hand, in order to prevent error in just those letters seldom called for in actual copying, special drills on these points of difficulty, for which "actual life" does not give adequate preparation would appear to be useful. Something is therefore to be said both for presenting actual life material and for abstracting certain acts from their context and rehearsing them in the form of artificial drills and exercises.

The frequency with which various letters and letter combinations appear in actual use might be made a basis for arranging the keyboard and for distributing the writing load effectively between the two hands and the different fingers. This becomes very complex, especially when attempt is made to study letter combinations as well as single letters. The present standard keyboard appears to have developed more or less at random, certainly without adequate scientific justification for its arrangement. A revision of the instrument itself would be a further curricular project for education.

Hoke showed by various tests on rate of tapping that the various fingers do not differ strikingly in capacity for such work. Certain letters are assigned to each finger, however, and combining the frequencies of use for these letters for each finger showed that some fingers were assigned a load four times as great as others. The following table summarizes these results.

	Left Hand				Right Hand			
	4	3	2	1	1	2	3	4
Tapping rate	113	119	129	136	145	145	131	128
Load given	803	658	1492	1535	1490	640	996	296

First and second fingers, right hand, showed about equal "ability," but one is given over twice the load assigned the other. Little finger, right hand, and second finger, left hand, have the same ability, but one is given about five times the load of the other.

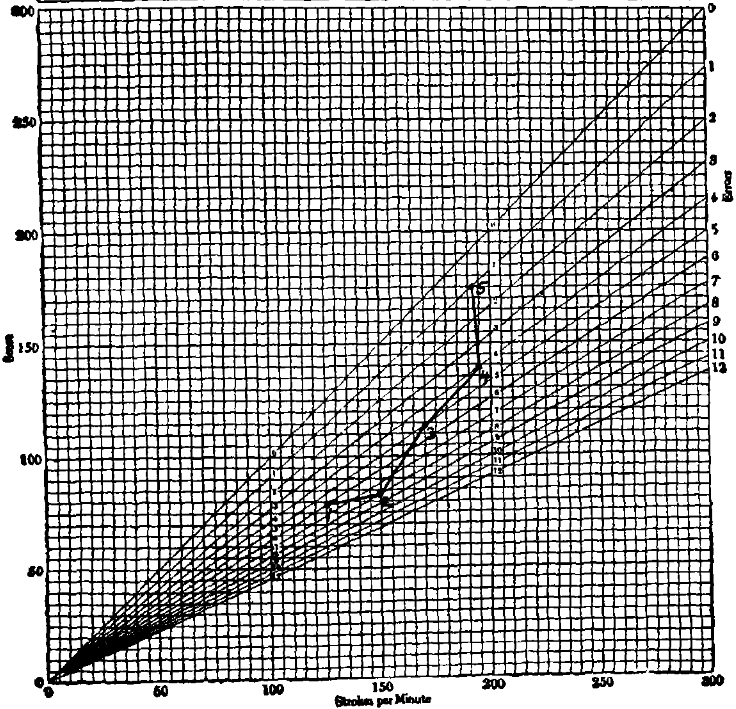
Hoke similarly criticizes the loads assigned the two hands. Although the right hand is in general about 10 per cent superior in ability to the left, the left hand is given the heavier load. In fact Hoke computed that the left hand is overloaded about 47 per cent as compared with the right.

On the basis of these and other considerations this investigator has proposed a new keyboard which he believes to be more psychologically correct. Contemplation of the difficulties to be met by any program which should seek to change at this time the "universal standard" keyboard now in common use throws instructive light on many of the problems of educational reform based on scientific analyses.

Measurements in typewriting. A variety of typing tests and measures are available. Such measures serve the same purpose in typing as is served by standard tests in any educational field. They may be used to check up progress, to indicate the need for special attention, to select the better of two applicants, to reflect the effect of various methods of teaching, to classify pupils. One of the more familiar sets of such material is the Blackstone test,[14] which will serve as our example.

On the basis of preliminary experiment on the effect of length of words, length of time and other variables, standard pieces of copy, containing about 350 strokes were developed in equivalent form. The examinee writes for three minutes, and the score takes account, through a simple formula, of both speed and accuracy. An individual progress record is pro-

Test	1st	2d	3d	4th	5th	6th	7th	8th	9th	10th
Form Used	A	B	C	D	E					
Date	1/14/22	4/16/22	9/2/22	12/5/22	3/7/23					
Months of Instruction	4	7	10	13	16					
Strokes per Minute	125	150	170	195	192					
Errors	6	8	5	4	1					
Score	78	83	113	139	175					



Courtesy of World Book Co., Yonkers-on-Hudson, N. Y.

FIG. 41.—INDIVIDUAL PROGRESS RECORD, BLACKSTONE TYPEWRITING TEST.

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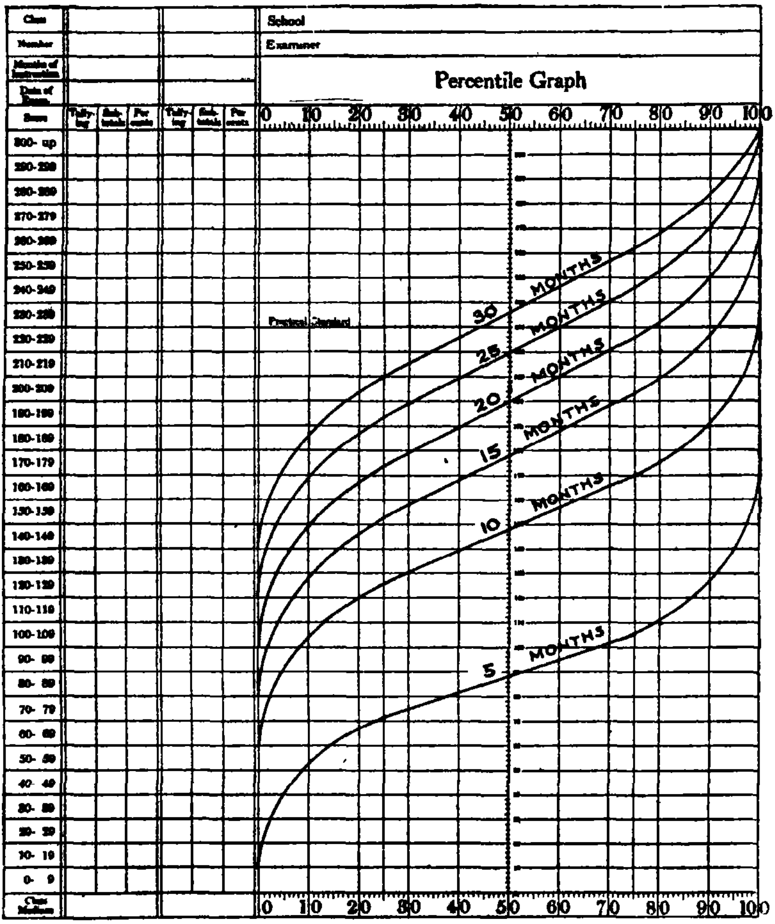
[14] *Blackstone Stenographic Proficiency Tests* (World Book Co., 1923, and later forms).

vided, in graphic form, so that the learner can on each occasion plat his score and observe the changes in proficiency in



Courtesy of World Book Co., Yonkers-on-Hudson, N. Y.

FIG. 42.—PERCENTILE CURVE IN TYPING FOR GROUPS WITH DIFFERENT AMOUNTS OF INSTRUCTIONS.

subsequent tests, thus providing both knowledge of results and useful motivation to improve.

Instructions are given on the class record sheet for the preparation of a percentile curve, showing just what percentage of the scores of the class is exceeded by the score of any individual, what percentage of the class attains or exceeds a given score, the range and variability of the scores, and the overlapping with scores of any other group.

Tentative norms of performance, based on over 2,000 cases, with amounts of instruction ranging from 5 to 30 months, are given, and percentile curves for the various groups with each additional 5 months of training are drawn. In the accompanying graphs are shown an individual progress record for five successive tests three months apart, and also a set of percentile curves for groups with varying amounts of instruction.

The function of the instructor. We might describe the rôle of the teacher of typing under the following convenient headings: [16]

1. Arranging the situation in the beginning, and throughout, so that the most useful habits will be most readily formed and the most effective cues most readily trained to the responses desired, thus eliminating many special difficulties and preventing the formation of useless or interfering adjustments
2. Adjusting the conditions of practice so that the physiological condition of the learner, the circumstances and the environmental influences will be as favorable as possible
3. Taking care that gains made are properly "cherished"—as by preventing "crowding" before the acts are well enough mastered, insisting upon accuracy first, and then upon speed as accuracy comes to be achieved; seeing that adequate warming up is accomplished before the press of practice begins
4. Making clear the steps through which the learning is likely to go, and, within the limits set by individual differences, seeing that these steps are moved through in the most effective sequence
5. Carefully noting the special sorts of error made by the learner, and since these are likely to vary and to be due to different causes at different stages of learning, pointing out the factors most probably responsible for them and suggesting devices for their early prevention or elimination
6. Assisting the learner to identify the sources of his gains so that he can give attention to those features of his work which enable him to effect further improvement

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[16] For many detailed suggestions see W. F. Book, *Learning to Typewrite* (Gregg Publishing Co., 1925).

7. By measurement of proficiency to make clear the progress being made from time to time, and to relate so far as possible the steps of gain to the changes in method
8. To pay special attention to particular difficulties and to the critical stages or plateaus which may appear and at these points to guide learning so that waste of effort and distracting or interfering general habits do not appear
9. Keeping alive the motivation or supplying additional motivation as needed, keeping the achievements closely related thereto.

PROBLEMS

1. As an example of sensorimotor learning, solve some mechanical puzzle repeatedly until you can do it automatically, taking the time for each solution and graphing these in the form of a practice curve.
2. Give a verbal account of the stages you observed your learning to go through in mastering this puzzle and consider the resemblance between this and learning to type.
3. If you can use a typewriter, secure some standard test and measure your present ability.
4. Collect errors you make in typing, classify them, and consider why they occur and what should be learned in order to prevent each type of error.
5. Type equivalent copy morning, noon and evening on five days taking your time and recording your errors. Average the three sets of results and see if you find one time of day better than another.
6. Test yourself again at this time and see what improvement you have made over the first test, given before this series of practices.
7. Analyze your own present methods of typing according to Book's account as summarized in the text, to discover what stage of learning you have reached, in general.
8. Read the account of learning telegraphy by Bryan and Harter, one of the pioneer experimental studies of learning, and discuss the results and conclusions with the class.

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CHAPTER XIV

LEARNING ON A SYMBOLIC LEVEL—READING

The meaning of reading. Reading, as a term in educational literature, is very loosely used. It may be used to indicate various activities associated with or employing language, such as speech, elocution, dramatic art, and the general field known as literature. It may be used still more broadly, as in referring to the "reading program," to indicate all those activities in which the use of printed matter is important, thus including geography, history, civics, and similar enterprises. On this basis arithmetic might also be included under "reading," as might also typewriting, stenography and bookkeeping.

Used in these very broad ways, reading comes to include a large part of the educational project, and all the questions of educational policy, objective, curriculum, come to be included in the topic. We are here to use the word in a more restricted sense, as the name for a certain kind of activity in which an individual may engage, to be contrasted with various other activities such as jumping, eating or sawing wood. Reading means certain ways of reacting to the stimulus of printed or written language. Jumping may be identified as a definite act, that may be used in various activities such as tennis, skating, and rope skipping. But these complex and variously motivated activities should not be confused with jumping. Reading also may be used as an instrument in many different activities, with none of which it need be confused.

The complexity of reading. The nature and variety of reading as an activity may be illustrated by a very simple example. Suppose the reader to be gaily driving his car along a country road. Sailing blithely round a curve and past the corner of an old barn he is suddenly confronted by such a sign as this:

STOP
FOR FOR
GAS GAS
AT
BILL'S BILL'S
PLACE PLACE

What will the driver of the speeding car *do?* A complete description of his behavior will introduce us to practically all of the psychology of *reading,* as distinguished from *literature.* His behavior will be very complex, and much of it will occur simultaneously. Without concern for the precise order in which the different things happen, let us examine them one by one in the order in which they occur to us as we think about him.

1. The big headline, STOP, catches the eye, and at once an *optical exploration* of the sign board begins. The eyes move about from point to point in order to "see what is there." This visual exploration is, in one sense, reading.

2. The sight of the visual pattern STOP leads promptly to loud or to silent speech. The driver says "Stop," either so vigorously that others could see him making these speech movements, or perhaps only so faintly that he alone, by the "feel" of his own speech organs, could be aware of the act. This phonation, naming or *pronunciation* of the word is, in one sense, reading.

3. He hears himself say this word, or if the pronunciation is silent he may, in addition to feeling his speech movements, mentally hear the sound which these movements, if more vigorous, would produce. This duplication of the seen word in terms of sound or *auditory imagery* is also in one sense reading.

4. The driver at sight of the word STOP bears down on the brakes and may completely halt the car, thus obeying the command of the printed word. This also in one sense is reading—the *execution of the act* of which the printed instruction is the name.

5. Various "thoughts" will "flash through his mind." Questions will occur, memories will be aroused, judgments will be passed, decisions made. Many kinds of "symbols" will be involved in this having of thoughts. Imagery, words, gestures, postures, eye-movements, distributions of tension throughout the musculature,—whatever be the most common symbols reflectively employed by the driver, will now be set into activity. The verdict may finally come which, in verbal terms, would be—"Oh, just an advertisement." This reaction of *intellectual understanding* is also, in a sense, what we mean by reading.

6. Varied feelings will arise—startle, at the sudden appearance of the familiar danger signal; annoyance, at the confused way in which the words are printed; amusement, at the joke; perhaps a mild esthetic relief occasioned by the symmetrical pattern, by the color, or by the sound of the words as spoken, their smoothness or rhythm of articulation. This *emotional reaction* to the printed sign, its esthetic appreciation, is also in a sense reading.

Here are at least six distinguishable things that may be going on, and all of them or any one or more of them may be called "reading." It should be clear that any account of the psychology of reading, its learning, teaching, improvement, must be related to one or other of these specific features, rather than to reading as a vague whole. And each of these main aspects is in turn analyzable into more elementary features which may deserve independent attention. Vague exhortation to "do more reading" or to "read better" can have little meaning, and therefore little educative value. Our own account of the psychology of reading will follow this preliminary analysis as a convenient guide.

Reading as visual exploration. Look at a word in the center of a printed page and note that the word thus *fixated* appears distinctly. Words next to it in any direction can be seen correctly but with less confidence, and only if familiar. To name words still farther away in any direction the eye must be moved so as to shift the clear area to that part of the page. This depends on the fact that only a rather small region in the center of the retina is capable of precise discrimination of such forms as words.

To read a line one moves the eyes along in jumps and pauses. It is in the pauses that the words are seen. The eye is then swung back to the beginning of the next line, usually with a single return movement. The amount of muscular effort and strain will vary with the number of these starts and stops, and these are more numerous the more difficult the material being examined. Visual exploration of the printed page has been much investigated. Eye movements have been photographed, timed, and otherwise recorded; their variation with individuals, with practice, with fatigue, with the nature of the reading response, and with the character and arrangement of the printed material have been studied in great detail.

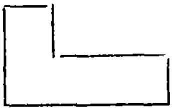
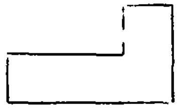
The exploratory movements vary in number, in regularity, in rate and in the duration of the fixation pauses. Their facilitation is promoted by regular line arrangement of the printed matter, which gives uniformity and rhythm; by lines not too short or long (about three inches is recommended); by print neither too large nor too small (10 point type is the favorite above the primary grades); by proper spacing, regular indentation, and uniform leading of lines; by optimum contrast of print and paper (black lettering on white gives the best results); by the absence of glare, as from shiny paper or wrong illumination; by the use of lower case letters instead of capitals, since the latter deprive words of much of their characteristic form.

Studies of the physiological area of distinct vision show that this does not ordinarily vary with reading ability.

When nonsense syllables or digits are used, good and poor readers differ but little in this respect. Distinguished from this optical area of distinct vision is the so-called "apprehension span" or "comprehension span"—the number of letters that can be seen with a single fixation. This is not an optical but a psychological factor, closely related to what we have called "scope."

When letters are presented in a single brief exposure the number "apprehended" varies with the report that is required. If the letters must be *named,* only 4 or 5 can be thus apprehended at a glance. If they have only to be *counted,* as many as 7 or 8 can be correctly reported. If the observer is required only to duplicate or indicate their *arrangement,* as many as a dozen items may be correctly taken in and arranged.

The span actually used in reading is shown by the number of fixation pauses in a word or line. It is often smaller than the "apprehension span" of which the reader is capable. It is smaller in oral than in silent reading, since pronunciation is a very specific report. Much attention has been given to the problem of *enlarging* the comprehension span in reading. Experiment shows that this increases with practice, and especially with the familiarity of the material read. But the nature of this process of span enlargement is often misunderstood.

Enlargement of reading span depends on cue reduction. Other things equal, it varies with the intelligence of the reader. Intelligence equal, it varies with the degree of learning. In dull learners, words must be *completely* seen to be recognized. Brighter pupils speedily come to know and discriminate words by slight cues, partial details or features. The word form may be sufficient if the general context is favorable. Thus if the story is about a dog and a cat, the mere appearance of such shapes as  and  may serve to identify the words "dog" and "cat" which, as a whole, have these respective "forms." The first few letters of a word may suffice, as in "d o"; or some subtle cue, such as the tail of the "y" in "kitty."

The old notion that words are recognized by first seeing the ABC's in them and combining these to make the whole has long been abandoned. It was perhaps sound enough in the days when reading was first taught by the use of capital letters, for the shape of both "dog" and "cat," in capitals, is only $\boxed{\text{DOG}}$ and $\boxed{\text{CAT}}$, rectangles of the same size, hence quite alike.

Experiment shows that ordinary words, and even phrases, are identified as quickly and easily as are single letters. But the degree to which this is done varies with the learning capacity (with capacity for cue reduction) and with scope for the cues afforded by the context (such as "the fact that the story is about dog and cat").

Broad span depends on whether slight cues, seen in marginal vision, or perhaps not visual at all, operate effectively, and on the readiness with which other context cues coöperate. Enlarging one's span is not a change in the eye. It happens when subtler and subtler cues acquire effectiveness in guiding recognition, pronunciation, expression, and interpretation.

Various techniques are used for promoting this change in a given pupil. More reading may help, since it increases familiarity with words. More rapid reading may help, for it invites reliance on slighter cues. Flash card exercises may give practice in responding to slight cues when exposure is too brief to admit of optical exploration. Calling explicit attention to the variety of cues available may help in those who have established the habit of relying upon only part of them. Phonic analysis may help, since it attaches vocal responses to parts of words (syllables), and these may themselves act as additional cues in the recognition of the word wholes.

The psychology of oral reading. If one goes far enough back into the origins of writing and printing, a stage is found in which the graphic signs were direct symbols of objects, relations, acts and events. The symbolism of visual language was based on *similarity*, some slight feature or cue of the object being also present in the symbol, or comprising it. A triangle might represent a tent; crossed lines, resembling sticks, would mean a camp fire; vertical or horizontal lines might stand for men erect or lying down. Such symbolism still survives in our Roman numerals, as I, II, III. Even the V is a contraction of five diverging lines, representing as many as the fingers on a hand; and X is only two such V shapes, put together.

But the psychological basis of reading, as we now know it, is more *indirect*. Printed or written words are no longer "pictographs." They do not in appearance resemble the things they represent. Instead each word as printed corresponds to a word as spoken—words have their sounds, their names, their phonograms. By the time the child comes to school he has already acquired the use and understanding of oral and aural language, and the teaching of reading begins at once to "tie the two sets of symbols together," to make the one the equivalent of the other.

In this way all of the previous background and experience of the pupil in connection with words spoken or heard may be taken advantage of to give "meaning" to the printed symbols. Reading, in its earliest stages, is typically oral reading—the delivery of speech sounds for which the words, punctuation, and arrangement on the page are equivalent or guiding symbols.

Oral reading may also introduce new elements, not indicated on the printed page. Shades of feeling and degrees of emphasis not represented by wavy or heavy lines of print may be represented by a quivering or a loud voice. Expression, as a feature of oral reading, is determined to only a slight degree by printed cues, such as punctuation and italics. It must be guided not merely by visual cues, as is more nearly the case in singing, but chiefly by responses of feeling and understanding which are themselves aroused by the reading matter, in the light of the reader's previous experience.

Oral reading may therefore be either perfunctory or expressive. Genuinely expressive reading requires not only a suitable background of experience, but the arousal of responses of feeling and understanding and their joint action (synergy) with the verbal cues of the printed page. Experimental studies have dealt mainly with oral reading of the more perfunctory kind, in which delivery of the vocal equivalents of the words, and due regard for punctuation, omission, repetition and pronunciation are the responses scored.

Cue reduction in reading. The process back of oral reading we have already indicated in the chapter on "Learning," but it will do no harm to review it here. Known objects (or acts, events, relations, feelings) already have their oral and aural names. Presented with the object, or often with a picture of the object, the pupil can deliver this speech name. Presented with a new printed word, he makes also a characteristic reaction, an optical exploration, of it. If the two, object and printed word, be now jointly presented, a total reaction to this total context will be made. It will include the optical and the vocal features, and we may diagram it as follows:

Antecedent		Consequent
Sight of the object and		Saying the name of the object and
of the printed word	→	optical exploration of the word

Thereafter, by the familiar law of cue reduction, either feature of the antecedent tends to produce the co-response. The sight of the word, with practice, comes to evoke, along with its optical exploration, the vocalized name of the object. This is *oral reading*.

Sight of the object may also provoke, along with other reactions, an activity of optical exploration appropriate to the visual word which is the name of the object. This optical reaction may in many cases be what is called the "mental image" of the printed word, which in such a case would not be visual but oculo-motor, an actual movement pattern with its attendant feeling (kinesthesis).

Such an "image" is more likely, however, to be both oculomotor (sensory) and visual (imaginal) since the original visual reaction to stimulation of the retina was also part of the *response* and may now be mildly reinstated by the partial cue. To go farther than this into the topic would involve us in the depths of systematic psychology, and besides, our present interest is only in the *vocal* response which constitutes oral reading.

When the *parts* of words (letters, syllables) have often been spoken, these parts come to have their own names. Often they are the same as short words (as the "cat" and "pill" in "caterpillar"). After seventy-five to a hundred familiar words are known by sight, naming of these *word-parts,* drill in *phonics,* may be used to assist in the pronunciation of new words and to clarify the pronunciation of words already somewhat familiar. Experiment and experience suggest that too much use should not be made of phonics; that they should not be introduced until a considerable number of words are already familiar; and perhaps not until pupils have already spontaneously observed the occurrence of identical elements in different words.

The problem of transfer and its control is here encountered on a practical plane. At least in English, phonic rules may lead astray, may be too freely transferred, and result in error unless there is adequate control by context cues, and often these too may mislead.

Too much attention to phonics also distracts attention from the larger units, the word wholes, the phrase units; may result in slow reading; may interfere with the more important steps towards reading silently for "meaning," by undue emphasis on vocalization. Just as in learning typing we have seen that certain aids once needed must be dispensed with if progress is to occur, so also overemphasis of phonics may result in habits which, if they persist, may be detrimental.

As a matter of fact, although oral reading is usually the first step, and the most expeditious way of beginning and of checking up and directing early progress, it must soon be not only abandoned as a habit but positively discouraged. Oral reading is slow and fatiguing. It is seldom actually used in modern life, except in the occasional reading of poetry or other expressive literature. Unless the tendency to vocalize the printed page is in due time reduced, progress in the various forms of effective silent reading will be handicapped.

The "noisy" reading of the primary grades becomes a nuisance, even to the pupil, by the time the third grade is reached. Efforts are then made to feature reading for understanding, to suppress vocalization, by special drills and exercises or tests calling for other kinds of action. The continued occasional use of oral reading for the purpose of teaching proper *speech* is a wholly different matter, and need not concern us; this method is used only to provide the pupil with something to say to the speech teacher, and there is much to be said for using spontaneous speech instead.

"Inner articulation," "incipient speech," "suppressed vocalization" then develop, supported by such imagery as may be available. So much of our use of language is vocal and auditory that only the most experienced readers become able to translate printed symbols freely into conduct and feeling. When "thought" is required, some such inner symbolization cannot ever be dispensed with, although it need by no means take the form of silent speech. And when reading is difficult, even the veteran falls back upon inner speech and often upon audible whispering or phonation.

What is going on in the shift from oral to silent reading should be clear by this time. It is again a simple case of cue reduction, in which through practice the printed words alone come to lead effectively to appropriate thought, feeling and action, without the support of vocalization and sound, once required.

This is precisely like what happened in typing, when the learner dispensed with vocal spelling, with finger exploration, and with motor-tactual imagery, and the letters of the copy led directly to the right key-striking movements. Typing, in fact, might be called a certain form of reading, in which the response is a manual rather than an oral one.

Scope as a factor in reading. The importance of scope, as distinguished from simple cue reduction, is shown in the case of oral reading by studies and measurements of the "eye-voice span." This is a name given to the distance between the word or letters being looked at, at a given moment, and the word or letters being uttered at that instant. In oral reading beyond its most elementary stage the eye runs ahead of the voice. The number of letters between the two points is used as a convenient measure of eye-voice span. The span at the beginning of a line is usually larger than at the end. Regardless of such factors, good readers have larger eye-voice span than poor readers, and the span, in general, increases with the school grade, at least up to a certain point.

In one study in the elementary grades, poor readers had an average eye-voice span of 8.7 and good readers of 13.8 letter spaces. Among high-school pupils the poor readers averaged 11.2 and the good readers 15.2 letter spaces.[1]

By virtue of this ability to fixate farther in advance of vocalization, the good reader is controlled by more context cues. His expression, his pronunciation of words is determined by words and punctuation considerably beyond and yet closely related to the words themselves. He is able to speak in larger units, in phrases or even in sentence units, and his oral reading is therefore not only more rapid but also more continuous, smoother, better organized and unified, better adapted to the total meaning of the text.

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[1] G. T. Buswell, *Eye-Voice Span in Reading* (University of Chicago Press, 1920).

Here, as everywhere, we find that scope plus cue reduction are equally important. Since these features jointly comprise intelligence, it is no wonder that reading ability correlates positively and so closely with intelligence as measured in other ways. In the school grades correlations ranging from .65 to .90 are found between scores on intelligence tests (which do not necessarily involve reading) and silent reading.[2] There is no reason to suppose that the differences in scope which in oral reading are called differences of eye-voice span are not of equal importance in silent reading for understanding or for following directions.

Score in oral reading is also closely correlated with the intelligence of pupils. The following table shows the average scores, on an age basis, of pupils in grades 1 to 8 in the schools of a large midwestern city.[3]

Beyond the fourth grade the average scores do not increase. Within a given grade the younger, and hence the brighter, pupils have the better scores. At a given age, up to about 13 years, the scores increase with school grade attained, this being again chiefly an index of brightness. It would appear, therefore, that oral reading, at least as measured in this way, is chiefly a function of intelligence, rather than of age or amount of schooling, beyond a certain minimum.

Reading for understanding. Reading for the sake of significance is more likely to be silent reading, although this is by no means necessary. Oral reading may proceed with no appreciation of significance, beyond capacity for pronunciation. It will, however, proceed better if significance is appreciated. Sometimes the chief motive of oral reading is the search for significance, or the endeavor to communicate significance, as in reading difficult material aloud, or reading aloud to others, or reading poetry or fine prose for the better appreciation of its artistry.

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[2] F. D. Brooks, *The Applied Psychology of Reading* (D. Appleton & Co., 1926), p. 13.

[3] W. W. Theisen, "Factors Affecting Results in Primary Reading," *Twentieth Yearbook,* National Society for Study of Education, 1921, Part II, pp. 1-24.

Average Scores of over 4,000 Elementary School Pupils, by Age and Grade, in the Gray Oral Reading Test

Grade	Ages										
	6	7	8	9	10	11	12	13	14	15	16
1	36	37	35	27							
2		50	48	46	42	42					
3			54	51	49	45	46	39			
4			58	55	53	50	50	44	52		
5				64	56	53		50	51	55	
6					57	55	51	53	50	54	
7						58	54	52	50	50	46
8							55	53	52	50	49

Reading for understanding, whether oral or silent, involves the use of the term "meaning," an unfortunate term which is responsible for much vagueness in psychology and logic and for some confusion in the literature of education.[4]

The importance, for the student of reading, of a clear understanding of the psychology of meaning may be illustrated by a number of citations from a recent and very suggestive volume on the "psychology of reading." The italics are our own, to call attention to the particular points of difficulty, confusion, contradiction, vagueness, uncertainty and sometimes unintelligibility.

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[4] For a detailed account of the psychology of meaning see the author's two volumes, *The Psychology of Thought* (D. Appleton & Co., 1926), Chs. xiii, xiv, and *Psychology, Its Facts and Principles* (D. Appleton & Co., 1928), Chs. vii and ix.

"Mental pronunciation, together with some motor tendencies . . . *is*, in a sense, the *meaning* of what we read."

On the preceding page we are told instead that "Mental pronunciation is probably *necessary to grasp the meaning*."

On the same page we are assured that it is "fitting the different parts of the sentence together" that *gives us* the meaning.

On the next page we learn that "*From experience* we acquire a stock of meanings, corresponding to various phases of our environment"; that we "*attach meanings* to words"; and "comprehending the *thought* of sentences and paragraphs" is "*a phase of meaning*."

On the following page, "the child *learns the meaning* of objects, or more precisely, *gives them meaning*." Also—"the meaning of an object is . . . our attitude toward it, *what we can do* to or with it or *what it is likely to do* to us."

On another page we are assured that a wide experience will "give a solid *foundation* to his *fund of meanings*."

"Primitive man," we are told, "*began to attach symbols* of some kind *to the objects* about him" and "symbols are the centers about which *cores of meaning* are grouped."

"Meaning *inheres in* the spoken word," but "*parts of meaning* are *split off*" as the result of discrimination.

Then we are told "Development *means* (1) a wider range of experiences . . ." etc.

The reader should now try to put these different uses of the term "meaning" together into a coherent account, and if he succeeds he will find the following section superfluous. We shall, however, give it for the sake of those who have difficulty.

An analysis of meaning. A symbol is always a *part* of some previous situation. Occurring now alone, or in some other context, it produces a response of the same kind as that originally made to the total situation. It is thus a cue, a sign, a partial stimulus. But it is this only when and in so far as it does produce a response appropriate to the situation of which it was earlier a part. In such a case we have an instance of "meaning," and our problem now is—What is the meaning?

The only answer can be that meaning is a name for the whole story we have just told—a sign or cue, functioning to produce a response, of the kind formerly aroused by the whole situation of which the cue was then only a part. And since this is a very complex story, we need more than the term "meaning" to refer to different parts of the process.

Meaning is not the cue; this is a sign, a symbol, an idea. Meaning is not the response; this is a movement, a feeling, or a thought. Meaning is not the object or situation that was originally effective; this was a birthday, a fright, a house, an earthquake, or some other total experience. Nor is meaning the arousal of the response by the cue. Meaning can be used intelligibly only as a name for the whole story. The confusion in the use of this word has come from the fact that some have used it to indicate the response, some to indicate the original situation, some to indicate the act of arousal, and some to indicate some wholly vaporous entity supposed to exist somewhere in "the mind." No wonder they have disagreed, and that we cannot understand them.

We will do well not to use the term meaning, but instead to use various forms of the word "signify." The cue or symbol is a *sign.* What it does is to *signify,* that is to arouse a response formerly made to a larger situation. This original situation, to which the sign "refers," is the *signified.* The response evoked by the sign is its *significance.* If we wish, we can say that the awareness that all this is taking place is the consciousness of meaning.

Now words, as cues or symbols, may arouse responses in human beings which we have classified for convenience as those of conduct, thought and feeling, or more usually some combination of these. And words may do all these things. As we saw in the beginning of the chapter, the sight of the word STOP made the driver speak the word and go down on the brakes. These were responses of overt movement. The word also aroused in him feelings of alarm, exasperation, amusement—responses of the second level. The word also aroused in him other symbols—such as images, symbolic postures, memories, thoughts, judgments—such as, "Oh, just another advertisement."

We have already considered pronunciation of the word in our account of oral reading. This is a very special case of an overt, muscular act, but one which is closely tied up with responses of thought and feeling, as we have seen. We have left then other types of motor conduct, feelings, and thoughts. The arousal of any of these by words in terms of their past contexts, is what we mean by *understanding* the word. Giving such reactions to words as symbols is reading for significance.

Reading and thinking. The influence of instructions (purpose), the effect of control by context (scope), and the importance of cue reduction (symbolism) in reading makes this act typical of all mental processes. Perhaps this is why the use of verbal materials affords the most convenient intelligence test. The characteristic procedures, sources of error and types of fallacy commonly met with in thinking, have their counterparts in the faulty responses seen in reading tests.

If scope is inadequate, the response, though appropriate enough to other occasions when the effective cue was present, may not fit the present occasion. A pupil reads silently a paragraph containing the sentence, "All the children except John had red hair, and his was brown." In reply to the question, "What color was John's hair?" he writes, "Red."

The sentence does contain "John had red hair," but this phrase is preceded by "except." Failure to incorporate this "except" in the effective context is due either to lack of scope or to failure of the word to have significance. In this respect lack of scope and ignorance operate in much the same way—both are a kind of blindness.

Thorndike,[5] in a series of articles on reading as related to reasoning, lists the chief causes of error as follows:

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[5] E. L. Thorndike, "The Psychology of Thinking in the Case of Reading," *Psychological Review,* May, 1917; "Reading as Reasoning," *Journal of Educational Psychology,* June, 1917; "The Understanding of Sentences," *Elementary School Journal,* October, 1917.

1. Over- or under-potency of elements
2. Dislocation or disrelation of elements
3. Wrongness or inadequacy of connections

The relation of this analysis to our own account in terms of cue and scope (symbol and organization) is clearly seen in the following paragraph:

> We must think of a pupil who answers the questions concerning a paragraph as beset by tendencies of each word and word group in the question (we may add—or in the paragraph) to assume undue potency, to be dislocated from its proper relations, and to call up its past accompaniments and sequents. For him to answer rightly means that an elaborate hierarchy of bonds is active and that an intricate set of forces maintains a balance of power.[6]

Special problems in the teaching of reading. Reading for significance implies some persisting cue or motive, which prescribes what kind of understanding (thought, feeling or conduct)—is to be produced. Such a motive is provided by the *instructions* or by the *purpose*. Without such special motivation, responses of all three kinds may be expected, or the response will be determined by incidental suggestions afforded by the environment.

The first problem of teaching to read for significance is that of providing vital contexts, contact with reality. The reader cannot get feelings from words unless he has previously gotten them from personal experiences of which the words now are cues. He cannot get intellectual understanding from reading unless he has first encountered the objects, relations and situations for which the words stand. He cannot read for directions unless he already knows for what acts the words are names. This is why the primary teacher first seizes upon the vocabulary of the child's speech, just as the geography teacher takes advantage of the topography of the local environment.

On higher levels such contact with reality must often be achieved vicariously. Through pictures, through the use of synonyms and simple definitions, and by reading of the experiences of others, background may "vicariously" be acquired which will give verbal elements, and especially the complex verbal relations and patterns in the sentence, their value as symbols.

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[6] E. L. Thorndike, *Psychological Review,* May, 1917, p. 232.

Having provided the background of reality, and having embedded these symbols in that context, the second problem, as in other fields, is that of cue reduction through drill or guided repetition. Hence the encouragement of reading, and the provision of interesting reading material becomes the chief concern of the teacher, after the level where the mechanics of reading are established.

The relation of speed of reading to comprehension has been frequently investigated, and the present emphasis is on the desirability of more rapid reading than in the past. As between individuals, studies show a positive relation between speed and comprehension. This may mean only that the more able pupils read both faster and with better understanding. But experiments also show that the average reader can increase his speed considerably with little or no loss of comprehension which probably means that most pupils read less rapidly than they might. We have seen in the same way that even a proficient typist can show remarkable improvement in speed, with no loss of accuracy, if the proper incentives are applied.

Various ways of reading for understanding have also been emphasized, determined by the practical uses to which reading is put. In reading the Sunday newspaper, often larger than the average book, a rapid scanning or skimming is to be recommended. In reading the telephone directory, first a rapid skimming, then a more careful inspection, and finally an exact noting of details as the correct name in the column is found, is desirable. In the reading of poetry it is often more effective to linger over the words and phrases. In reading descriptions of arithmetic problems much attention to context, with special attention at crucial points is called for.

Each practical *use* of reading thus calls for a technique of its own. Intensive practice in any one method or habit does not train the reader for other methods, and it seems wise to give explicit practice in these various methods, thus promoting adaptability and flexibility rather than an inflexible speed and degree of comprehension.

Comparison of the various practical techniques in the teaching of reading is still in the experimental stage. Different methods and "systems" place the emphasis on different points; distribute the time in different ways; use somewhat different materials and choose the reading vocabulary in somewhat different ways. It seems clear at any rate that some methods are superior to others, in the hands of certain teachers, at certain levels, and with certain pupils.

The following graph[7] shows reading scores for speed and comprehension in two different schools, for the various grades. The solid heavy line gives the average attainment for schools in general. The other lines show the scores for the two different schools. One school is above the norms, in all grades, both for speed and comprehension. The other school in all grades is below the norms in both respects.

Such results as this may come from differences in the general intelligence level of pupils in different schools, or they may depend on differences in the method of teaching reading, on the general attitude toward reading, and on the success with which wide use of reading is encouraged, both in and out of school. Any detailed discussion of the relative merits of various systems of reading methods and readers would be beyond the scope of this chapter.[8]

Scales and tests for the measuring of reading ability were used as illustrations in the chapter on "Measurement in Edu-

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[7] For a further description of the conditions back of such differences in reading score see D. Starch, *Educational Psychology* (Macmillan Co., 1927), in connection with Figures 59 and 60 of that text.

[8] On this topic the interested reader should consult the Report of the National Committee on Reading, published as Part I of the *Twenty-fourth Yearbook* of the National Society for the Study of Education, which has been described as "the most comprehensive, unbiased, authoritative and helpful manual on the subject of reading now in print" (A. I. Gates, *Elementary School Journal,* June, 1925).

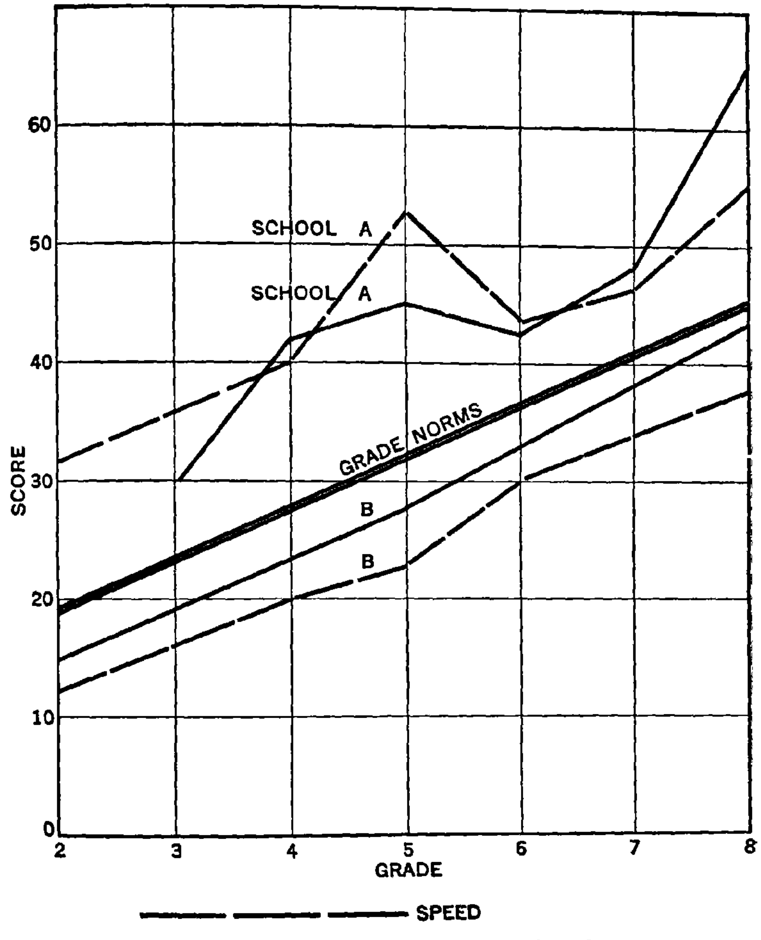

FIG. 43.—SHOWING ACTUAL ACHIEVEMENTS IN READING, SPEED AND COMPREHENSION, IN THE GRADES OF SCHOOL A AND SCHOOL B, COMPARED WITH STANDARD NORMS FOR THE VARIOUS GRADES.

School A is uniformly above the norms, School B uniformly below the norms, both in speed and in comprehension.

cation." There are now innumerable tests for this purpose on the market.[9] They vary strikingly in usefulness, in reliability, in carefulness of preparation, in the dependability and significance of the norms provided, and also in validity. Some of them are not reading tests primarily, but tests of general intelligence. Only a detailed knowledge of the field of educational measurement will enable the teacher to use reading tests with insight. The cases used in the chapter on "measurement" may be referred to as examples of the nature and purpose of tests and scales in reading.

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[9] For a suggestive experimental and statistical critique of various reading texts see A. I. Gates, *Journal of Educational Psychology*, September, October, and November, 1921.

Rules for the improvement of reading. Among the various general and detailed principles for promoting effective reading habits, the following may be cited as useful and typical, for those in whom the mechanics of the process are already fairly well established.

1. Emphasize silent rather than oral reading. If vocalization, then silent speech, then inner speech, and finally the more concrete forms of imagery can be reduced or eliminated, the text itself, as the symbol of other realities, may lead directly to comprehension in terms of responses of thought, feeling and behavior.
2. Emphasize speed, at least to the point of being capable of it. The greater the speed the larger the effective scope and the subtler the cues that will need to operate. Comprehension may not suffer, and a greater range and variety of reading experience may be achieved.
3. Emphasize the thought, the response to the text, rather than the symbols there offered. Learn to adapt the distribution of attention and the technique of exploration to the practical use to which the reading is put at the moment.
4. Practice putting the outcome of reading into terms of your own thinking. Frequently pause to "sum up" or state in your own way the significance of the text, thus learning to free yourself from the precise words and symbols there used. It is not the symbols, but the realities for which they stand that are important in most reading.
5. Practice discrimination. Choose the things read with some reference to their intrinsic value and interest. This will strengthen motivation and help prevent the establishment of routine and perfunctory reading habits.
6. Read much and widely. Disuse is as effective in weakening techniques of reading as it is in other skills of similar subtlety and complexity.

7. Pay attention to the general environmental influences that may promote or interfere with speed and comfort in reading. Proper attention to the needs of the eye, glasses when required to eliminate strain and fatigue, suitable illumination, proper paper and printing are among these items.

8. Frequent testing and measuring with standard scales will afford useful indications of progress or failure to progress and may also afford incentive for modification and improvement.

The reading program. Abstractly considered, reading as an instrument or skill may be distinguished from the further uses to which that tool is put. Once the art of reading is fairly well accomplished, this becomes one of the chief instruments of vicarious experience, and hence one of the chief avenues of instruction.

Actually the two functions develop, or should develop, together. Part of the development of reading as an art consists in the acquisition of a vocabulary, or the extension and refinement of the initial oral vocabulary. This very process is information; words are ideas; the material read about may thus become as important, at an early stage, as the practice in reading mechanics. Skill in reading facilitates operation in other fields; in turn, work in these fields continues to perfect the art of reading.

An important part of the school's work in connection with reading thus becomes the selection of the content of the reading assignment, a determination of the uses to which reading is profitably to be put. This is the problem of the reading curriculum. As we shall see in connection with a later chapter on curriculum construction, this problem is closely tied up with the general conception of education, with problems of objective and aim. What the pupil shall read thus becomes more than a psychological issue and involves many issues beyond the general principles of psychology. The field is thus so extensive that no attempt to survey it seems feasible in this general review of the psychology of education.

PROBLEMS

1. Observe yourself while reading and note the degree to which silent speech, suppressed articulation, and mental imagery are present.

2. Place a mirror in front of some one else who is reading, alongside the page, and watch in the mirror his eye movements and pauses, their number, duration, and general character.

3. Find a line that is all capitals and one that is in lower case of the same size. Measure the distance at which the two lines can be read by several people, starting too far away and approaching until everything is read correctly. What is the significance of your results?

4. Turn a page upside down and try to read it aloud. Note which words give special difficulty and try to discover why this is the case. What do you do when in difficulty? How does your experience compare with that of a child just learning to read?

5. Cut a small hole in a sheet of paper, just big enough to expose a word of print at a time. Try to read a page by moving this slit along, uncovering the words one at a time. What features of the psychology of reading does your experience emphasize?

6. Time yourself in the silent reading of a page and write out a full account of what you have read. Repeat twice daily for a week, each time trying to read more rapidly. Can you increase your speed appreciably with no apparent loss of understanding as shown by the completeness and accuracy of your written accounts? (You will of course use a different page at each trial.)

7. Review the way you learned to read a foreign language and compare this with the account of cue reduction and scope given in the text. Do the two cases appear similar?

8. Write out a description of all you can observe taking place when you try to read a new verse of poetry so as to get its full meaning. Classify the reactions in terms of the modes of response enumerated in the text, and discuss the results.

9. Keep a record for a week of every occasion on which you see or hear the word "meaning" used. Bring these together and compare them to see what they have in common and to what degree the term is used consistently and systematically.

10. Look up the topics of "congenital word blindness" and "word blindness or deafness" and consider what bearing these topics may have on the teaching of reading.

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CHAPTER XV

KNOWLEDGE AND THOUGHT OUTCOMES—SCIENCE TEACHING

Skill, knowledge and appreciation. Traditional psychology distinguishes between action, thought and feeling; education similarly distinguishes between skill, information, and appreciation. In the mastery of typing the pupil's main achievement is the acquisition of a useful sensorimotor skill, a tool that may be used in various ways. Except for slight incidental features, the pupil is neither wiser nor more appreciative.

Reading, as an art, is more likely to introduce also, along with its mechanics, information and appreciation mediated by the content of the reading lesson. Handwriting, sewing, sawing and planing would belong with typing as skills or tool subjects. A foreign language might be considered to belong in such a group if conceived only as an instrument of communication. The study, with no attempt at creative production, of poetry, architecture, music, painting, might emphasize either the aspect of information or that of appreciation, depending on the way the study was conducted.

Social, physical and natural sciences. There is on the other hand a group of educational activities concerned more definitely with knowledge and thought. These are the various science fields, such as the physical, the biological and the social sciences. Their teaching aspires on the one hand to acquaint the student with certain features of the natural world. On the other hand it aspires to cultivate or encourage in him habits of thoughtfulness and an effective mental technique of inquiry and problem solution. If, incidentally, the student also acquires useful manual dexterities or valuable appreciations, such as drawing, or a sense of mystery, these would also be welcome attainments.

In the elementary grades these three fields begin to be represented. Social sciences appear as geography and history; biological sciences as nature study and physiology; the physical sciences appear most definitely in the form of arithmetic. In the high school such instruction is continued either as "social science" and "general science," or by a more definite division of labor, as physics, chemistry, mathematics, botany, history, civics, and the like. Although there is agreement as to what is to be hoped for from such education, no one method has met with general satisfaction.

The teaching of science in the secondary school, in spite of its long history, must be said to be still in the experimental stage. At this stage the contribution of psychology is likely to be highly general or else very specific and restricted. By way of general contribution, psychology can make clearer the nature of thinking, so that science instruction may be better adapted to it. More specific points would be concerned with limited experimental determinations of such things as the relative effectiveness of different types of instruction, methods of presentation, and measurements of outcome. There are, however, in all the fields of science instruction, many problems of a middle range of magnitude which await more careful psychological study. These would be illustrated by studies of the actual way in which specific concepts and principles emerge in the thinking of the individual—such concepts as cause, energy, proportion and the like.

The objective of science teaching. The aims of science teaching, as now commonly stated, show what a complex enterprise it is, and perhaps sufficiently excuse the vagueness of our current psychology of science in education. Science covers all human experience, hence the problem of selection and organization of activities, topics, or projects is difficult. On the one hand there is the temptation to range too widely and unrelatedly, giving scraps of interesting experience and dramatic bits of method. Such a procedure fails to give a true impression of the actual rigorous character of science.

On the other hand there is the temptation to divide the field into convenient specialties, with the danger that teachers, absorbed each in his favorite subject matter, fail to emphasize the scientific procedures and attitudes in their bearing on life in general and especially on practical reflection and conduct. The middle course is difficult to steer. There is still, therefore, a variety of procedures, ranging from general "orientation" courses to highly departmentalized methods. The procedure adopted also varies with the educational level, but even on the level of college education orientation and survey courses are always being revived and tried out.

The specific aims or objectives of science teaching have been stated as follows:[1]

1. The acquisition of useful information
2. The formation of useful specific habits
3. Adoption of valuable ideals, or "emotionalized standards"
4. Acquisition of facility in the use of facts, ideas, and methodical thought processes, for problem solution
5. Development of taste and power of appreciation
6. Development of scientific or philosophic insights, perspectives and attitudes of mind that serve as safeguards to the intelligent interpretation of contemporary life

The psychology of arithmetic. In order to escape the vagueness of the larger fields of knowledge, let us consider the case of elementary arithmetic, a relatively restricted, though in itself enormously complicated, branch of science—the science of number. If psychology could describe the way in which the science of number arose historically, the way numerical ideas develop genetically in the child's early years, and could inventory descriptively the pupil's status in this regard upon arrival at school, a useful step would have been taken. There is, however, in spite of many such studies, no close agreement on these details.

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[1] G. R. Twiss, *Textbook in the Principles of Science Teaching* (Macmillan Co., 1917).

Numerical relations are facts of nature, just as are colors, noises, aches and pains. We perceive and react to these relations without knowing their names. An infant soon reaches *farther* for a distant object than for a near one; this recognition of *degree* is reaction to a quantitative fact. Even a chick may be taught to react specifically to the *larger* of two objects, again a quantitative factor. In the perception of *groups*, such as a pair, a team, a trio, numerical facts appear; such names as pair, trio, team, few, many, crowd, may be said to be numerical terms, the names of certain *collections* of smaller *units*.

In serial arrangements each object has its *position* and this position may be named—as the first, the last, the middle. Or they are named by ordinal numbers—first, second, third, or by the cardinal numbers, one, two, three. Children early hear these names used by adults and long before coming to school they have come to employ some of this symbolism for numerical experiences. Ratios, proportions, and other relationships are facts easily and early observed. A pair of cookies for a trio of infants, more marbles than the single fist can grasp, are quantitative problems early encountered in a practical way and often effectively solved by infants.

By the age of six months the average infant has learned to "retain transient hold of two cubes" by using both hands instead of one. At the age of three years it responds to the memory span test of "three digits" by naming the three given by the examiner, and in the right sequence. By the age of four years the average child can count four pennies and has a digit span of four. By five years it can give its age correctly, and can pick the heavier of two small weights. Upon entering school at six years the average child can already count thirteen objects in a row, knows the names of four familiar coins, recognizes the incompleteness of the standard test pictures. All these represent achievements in the field of quantitative relations and number, and they are but fragmentary indications of a complex development that precedes the experience of school instruction.

Arithmetic, the manipulation of symbols. Arithmetic deals with these quantitative and numerical aspects of experience, *abstracted* as quickly as possible from the concrete cookies and marbles. Relations may remain the same when the objects or fundaments exhibiting them change, just as the nation persists while its citizens constantly change.

Arithmetic therefore requires the development of *symbols* for numerical properties, and speedily becomes limited to the manipulation of these symbols, returning to *reality* only to apply the answer or outcome. In general, a mathematical solution is a much abbreviated experiment or manipulation. But in place of actually carrying out the experiment with marbles, pies, or dollar bills, we manipulate symbols according to rules and conventions. Each symbol and each rule takes its origin in actual experience of number facts and relations. But the essence of thinking consists in the fact that this play of symbols is *substituted* for the overt manipulation of and experiment with objects. Arithmetic is thinking, in one of its purest forms.

Consider a simple case. A dying shepherd wishes to divide his flock among his three sons. He need not actually pick up the sheep and deposit them in the respective pens. He can take large sticks or pebbles for big sheep, smaller ones for lambs, and by sorting these objects arrive at an equitable division of his flock. But then he is *thinking;* he is manipulating symbols for their symbolic value. The mere fact that the symbol is an actual object, a stick, or pebble is unimportant; *every* symbol is also an actual object, in its own right, as well as a symbol.

Our number names, our figures, our arithmetical signs, such as +, ×, and words such as sum, multiply, difference, are just such symbols. Arithmetic is the study of the nature, meaning and management of these symbols. The fundamental operations—adding, subtracting, multiplying, dividing, are arbitrary symbolic ways of carrying out such operations as counting, grouping, breaking up into parts, balancing, and otherwise arranging objects in quantitative relationships.

Initially, physical "counters," such as pebbles, notches, the fingers, were used for these processes, and the *counting* was still actual. The fingers being but 10 in number, gave the decimal base to our notation and reckoning. Each *digit* stood for a counted unit; when 10 had been reached, a mark or notch might serve to indicate one "hand-full," and counting could begin again. The hand-fulls were higher units, the tens groups.

Now we substitute for the "counters" the written *figures*, but we still put the digits in one row, and we put a mark in front of a digit to indicate an extra group of 10. The invention of the zero is said to have marked a significant step in arithmetic, and the loss of it from human thought for a period held up the progress of arithmetic until it was again invented.

Aims of science teaching, illustrated by arithmetic. 1. *Useful information.* This is the provision of important experience, directly or vicariously, which the pupil might not otherwise discover, but the knowledge of which would be useful. Actual presentation of arithmetical relations, such as the fact that multiplying can be used to check division, the relation of a diameter to a circumference, the derivation of areas from linear dimensions may serve as examples. Still humbler cases would be the teaching of number names, teaching to count, to divide, to combine fractions, information concerning weights and measures.

2. *Specific habits.* The operations, conventional in character, yet supported by certain logical facts, must be specifically learned, whether or not their origin and justification be understood. Keeping figures to be added in a straight line; distinguishing between numerators and denominators; recording the units and "carrying" the tens; doing one thing when + is there, another when × or — is there as the cue; and all the special responses that constitute the tables and combinations

of number values would be examples. These habits are so specific that a slight difference in arrangement from that learned as a child may be enough to upset the computations of adults. Placing the quotient in long division above the dividend instead of to the right of it, is a common instance of such confusion.

The specificity and great number of these habits is often not appreciated, even by the teacher. Thus ordinary addition of a column of two-place figures involves at least eight major processes, "each of which is psychologically distinct and requires distinct educational treatment."[2] These are:

1. Learning to keep one's place in the column
2. Learning to keep in mind progressively the result of each addition
3. Learning to add a seen to a thought-of number
4. Learning to neglect an empty space in the column
5. Learning to neglect zeros
6. Applying the simple addition combinations (as 8 + 5) to the higher decades (as 28 + 5)
7. Learning to write the figure signifying units rather than the total, as in addition of one-place columns
8. Learning to carry the tens figure to the next column

Each of these steps is in turn dependent on the previous establishment of many specific habits dealing with the various addition combinations, and this complexity is present in spite of the fact that addition is one of the simpler operations.

Much of the applied psychology of arithmetic is occupied with the attempt to determine the most effective sequence for acquiring all these specific habits, the degree of skill to be accorded each, the most economical distribution of this drill in keeping with all the other demands of the subject, and the best way to provide for the facile recognition of when each habit is called for.[3]

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[2] E. L. Thorndike, *The Psychology of Arithmetic* (Macmillan Co., 1922), p. 52.

[3] See Thorndike, *op. cit.* for such details. Also D. Starch, *Educational Psychology* (Macmillan Co., 1919), Ch. xx.

3. *Valuable ideals.* The writer once had pedagogical troubles with a pupil who asserted that 50 per cent of 100 "is about 40." When remonstrated with, he replied that that was "near enough." Although twelve years old, he had never studied arithmetic, and he lacked the "valuable ideal" of accuracy. The intellectual feelings, underlying our perception of correctness, precision, adequacy, are only mild emotions. Since emotions are easily transferable, and since arithmetic offers such a definite check upon habits of disorder, irregularity, lack of system, hasty conclusion, it is believed that this study may contribute numerous collateral gains by way of such ideals.

4. *Facility in the use of facts and thought processes.* A very large part of the teaching of elementary arithmetic is drill. Once cue reduction has reached a point where the sensory presence of objects and their numerical arrangement and relations are not needed, the next problem is mainly that of further cue reduction. Only by repetition and use can the innumerable responses, such as 81 to 9×9, and 9 to $81 \div 9$ be established. In the beginning, actual counting may be needed. This is in time dispensed with, and the play of symbols must be so rehearsed that error is rare.

The process is the same as that observed in typing and reading. Counting on fingers, going back to 9×1 in order to reach 9×9, and similar "crutches" are relied on. But effective teaching does not tolerate these overt aids longer than necessary. In difficulty we all revert to these once needed stimuli and antecedents, just as when balked in typing, we fall back on motor-tactual imagery, or feeling for the keys with the fingers.

5. *Taste and appreciation.* A sense of the validity of arithmetic, a confidence in reasoning and in the value of orderly mastery, an appreciation of the logic of number, of the inexorable nature of mathematical truth, develop in proportion to the insight and intelligence of the pupil. Even if this appreciation extends no further than the realm of number,

since number is so general an aspect of life, this gain is important.

6. *Scientific insights and attitudes.* Whether the insights and problem-solving cautions exercised in arithmetic extend so widely as to give "safeguards to the intelligent interpretation of contemporary life" may be doubted. The same doubt may arise in connection with any of the sciences. It has even been argued that over-occupation with science may have just the reverse of this effect and may bias rather than broaden one's outlook. This, at least, ought not to be the effect of science study.

Arithmetic as reasoning. At any rate there is in arithmetic ample opportunity for the exhibition and use of problem-solving techniques, as distinguished from simple drills toward automatic accuracy in the fundamental operations, and this is the third chief task of teaching. This opportunity appears in arithmetic as *reasoning* rather than as *computation.* It is one thing to add with speed and precision, when the instruction or cue to "add" is given. It is another, though a very similar, thing to confront an oral, or written, or thought-of problem with no instructions save "What is the answer?", to select from the data given the significant items, dismiss the irrelevant, and perform with the relevant items such operations as the *total problem* requires.

The difference is that which we have repeatedly encountered—between learning and sagacity, cue reduction and scope or organization. Consider the pupil faced with the following problem:

> I went to the store on the corner at 9 A.M. and bought 6 yards of muslin at 40 cents a yard, leaving the store at 10 A.M. How long was I in the store?

Such a problem is strongly disapproved of by reformers in the field of arithmetic, on the ground that it tricks the unwary pupil and encourages wrong rather than right organization of habits. The argument is based chiefly on the conception of learning as drill; it may be sound, although no evidence is available to show that problems that catch the unwary and problems "remote from life" do not teach arithmetic quite as well as the sociologically approved ones, based on butchers' bills and the measurement of milk. For our own purpose the problem here given serves as a more lifelike situation than those in which all but the relevant items are deleted. The problem is much like that faced by a man about to make up his income tax.

Scope, or sagacity. The first question that arises is, "What items are to be dealt with?" Adults have been known to add the date in with their bank balances. Was this perhaps because the arithmetic books, with their sociological motives, had excluded from the descriptions of problems all figures not to be dealt with in the computation?

The question, "What items are to be dealt with?" is the problem of scope—the problem of allowing all the features of the situation to influence the response in terms of their relevance and relations. The pupil who is "touched off" by "6 yards at 40 cents" and adds or multiplies, resembles the neurotic soldier; the veteran who dropped his bundle when the joker called "Halt!"; the man who left the elevator at the wrong floor; the child who spelled "conductor" CONDUKTER.

His computations might be ever so accurate, but his reasoning would be wrong. If he had comprehended the whole problem or situation he would have ignored the 6 and the 40. If he had allowed the final question its due weight as a persisting irritant, the words "How long in the store?" would have facilitated operations with *time* items, rather than with *cost* units; he would have subtracted the hours instead of going astray.

Joint action of cues and controls. We have here the essentials of *reasoning* activity. Manipulation of symbols under the influence of a symbolic context, that is reasoning. As is true of all human action, it is aroused by a trouble, a lack, a distress, however minor. Depending on the past contexts of this distress, a field or group of operations is favored; cues from the present situation bring into play acts from this set. If available cues operate jointly and their respective responses have been adequately trained, the net outcome will be the best adjustment possible on the basis of the actor's experience and training.

The two factors, aside from the motive, are the previous learning and the present scope. Whether scope or sagacity can be changed by practice, encouraged or discouraged as a habit, is still uncertain. Science teaching in general proceeds on the faith that this can be done and that the change will not be wholly limited to the field in which the learning occurred. This is, of course, the doctrine of formal discipline, once most vigorously challenged by the claims of science teaching, and now in turn invoked by it.

Because of the neat way in which both symbolism and scope are involved in arithmetic, this activity serves, along with reading, as excellent material for the construction of "intelligence" tests. In fact, in the written reasoning problems, much of the success is determined by comprehension in reading and by the same influences of meaning and context that operate in exclusively verbal material. It is likely that arithmetic problems serve better than any other school materials for the detection of faulty habits in reading.

The function of arithmetic. From what we know of the native determinants of intelligence, the nature of learning, and the limits of transfer, it seems best to find in arithmetic itself the justification for its inclusion in the elementary curriculum. A drilled accuracy and reasonable speed in working with integers and fractions in the fundamental operations, an acquaintance with the more important number relations and the more useful tables of weights and measures, a beginning comprehension of common practices involving arithmetic, such as interest, per cent, finding areas and volumes; and such scope as can be achieved in the organization of the details of a practical problem—these alone, as an important part of the equipment of the average man, would justify arithmetic.

On the higher levels of mathematics the change is chiefly one of increasing abstraction and symbolism. In algebra even the numerical unit values, as represented by such numbers as 45, 76, $3.50, drop out. In their place the more subtle letter symbols—a, b, c, x, y, etc., represent *any number* value, determined only by its membership in the general system of number relations. The equation, instead of representing a specific experiment, performed in fancy, that is, symbolically, applies to the common elements in a large number of such experiments. The item symbolized thus becomes more and more abstract and subtle. The higher mathematical operations do not really get farther away from reality. Even in their most abstruse forms they symbolize concrete manipulations of sensory experience. But their *generality* becomes so great that the actual experiments may not even be capable of execution on the *plane of sensory experience in any ordinary period of time.*

The nature of concepts. Science teaching is much occupied with the development of *concepts.* It is useful for the educator to have a clear concept of the nature of a concept. A concept, such as that of mass, energy, species, least common denominator, variability, heredity is not a mysterious somewhat that hangs between the symbol and its reality, between the sign and the signified. The concept *is the symbol,* as it stands for or represents the single *abstract* feature of experience to which it belongs, that is, for which it is conventionally adopted as the sign.

No "mental concepts" hang between the symbol and the thing or situation signified. The concept "pain" is the word PAIN, in so far as it functions for the common elements of varied particular hurts; or it is whatever other symbol (such as an image, a gesture, an eye movement) at any given time plays this *surrogate* role.

A thought or concept is not something in addition to or over and above the symbol. The important thing about a thought is not what it is made of, but the response made to it, the acts and consequents to which it leads in terms of the past situations which give it its significance.

Concepts in arithmetic. The practical problem that arises is whether concepts should be fully developed, defined or understood before they are used. In arithmetic, for example, numerous concepts arise. The sign + is such a concept. The phrase, "invert the divisor," the instruction, "carry the tens," are similar concepts (or rules). The actual *understanding* of such concepts or principles, the reasons for their use, demonstration in concrete experience of what actual operations the conventional habits imply, may be sought first. But should this be done, and can it be done?

Or should the practice simply be taught as an arbitrary rule? The pupil might then be expected in time to develop confidence in the practice by finding it to "work." Later on he might be led to understand why the practice or principle does work and just what it means. If we look elsewhere for analogous situations we find that this is the method often followed. We teach children that a given spelling is the *correct* one. There are, of course, historical and etymological reasons for this, but we do not require the pupil to appreciate the etymology before undertaking the spelling. In fact, only by first learning to spell is he able to undertake the study of etymology. The two in a way must grow up together.

As a matter of fact many adults have had the experience of suddenly seeing for the first time the *reason* for arithmetical or statistical habits and formulæ they had employed successfully for years without knowing *why they worked.* The feeling is natural then that if this understanding had been available at the time the practice was learned as an arbitrary habit, learning would have been promoted and interest in arithmetic and statistics quickened.

The evolution of concepts. The best solution of the question is probably a compromise. In a sense, principles are best understood through their use. Use and understanding develop together. A concept, symbol, or cue becomes such only in so far as it does actually *lead* to a later act or event. But only, it is true, as this leading is determined by past contexts. The philosophic or logical justification of a principle is often beyond the level of appreciation of the elementary pupil who may need to use it. It is often the result of a long historical development, and may represent relations arrived at only slowly even by historical thinkers. In such a case the actual *working value* of the rule or principle or technique is perhaps the best grounds for its first teaching.

On higher levels of science teaching, much the same thing is to be said. The concepts of a species, of evolution, of heredity, achieve their fullest significance only through the perils of their use. Concepts are not mental patterns that can at first be formed, then put into practice. The meaningfulness of the concept depends upon and varies with its actual use, just as the usefulness varies with the fullness of comprehension, the rightness of the background for which it stands. Thanks to language, written and spoken, vicarious experience in the form of definitions, synonyms, verbal analogies, diagrams and other "explanations" can be used to good advantage. Pies do not have to be actually baked in order to be divided. A circle drawn on the blackboard serves as an adequate "thought of" a pie. The "didactic" apparatus of science is therefore only a method of providing vicarious experience, an intermediate symbolism between the basic experience and the subtler symbolism to be acquired.

Generalization in teaching. Science is largely occupied with abstractions, with features common to many diverse experiences but not existing in isolation. Color, for example, never exists alone. There are always with it other features such as shape, brightness, distance, duration, direction. Neither do direction, duration or shape, or any other features occur in isolation, but always buried among many other discriminable aspects of concrete things.

This makes it difficult to teach about duration or brightness or any other single feature, such as those which science abstracts from experience. Such abstractions or generalizations must be promoted by conscious instruction. The techniques are several, and they are applicable to all teaching.

1. *Emphasis by attention.* By pointing or verbal direction of attention one after another feature of a concrete experience may be indicated and named. Thus "five-ness" may be distinguished from color, posture, size, of boys shown in a picture. "Intensity," as a tonal concept, may be identified by singling out in turn the duration, the pitch, the timbre, and the loudness of a sound. "Tenor" may be identified by pointing out the high, low and middle voices of a chorus.

2. *Varying concomitants.* "Intensity" may be taught also by presenting sounds alike in this respect but different in all or many other regards. "Vertical" may be taught by showing, in turn, an erect man, a towering steeple, a ruler, pencil or broom, all differing except in position with respect to gravity. "Five" may be discovered by responding by "Five" to five boys, five apples, five books.

In this way, the response becomes attached most closely to the common element, appearing more frequently than any other feature in the diverse stimulus patterns. Unless adequate variation of context is employed, this may not be the case, and some irrelevant feature or features of the first few examples may become the cue to action. The babe responds by "dog" to *any* furry animal; the pupil says "vertical" only when a *ruler* is held up.

It is, therefore, important to stress also the varying concomitants, and to react specifically to *them,* as well as to the common element. Not "five" always, but "five boys," "five books," "five apples" should be the first responses. The diversities as well as the community are thus named. Perhaps this technique is the best that can be recommended to assure the utilization of scope and to promote it within the limits made possible by the native characteristics of the pupil.

3. *Contrast.* Another technique is the reverse of the foregoing. Presenting situations *alike* in every respect except the

element of interest at the moment serves to emphasize this element and its opposite or absence. In this way one-fourth and four may be distinguished. "Intensity" may be featured by presenting tones alike in other respects, but varying in loudness.

All these are simple and fundamental techniques to be used in assisting the learner to "attach" the conventional symbols to particular abstract features of his experience, and to become specifically aware of these features although he cannot encounter them in isolation. As this process goes on, the *concept* is developing. This, in fact, is all that is meant by the evolution of concepts; this is generalization. It is the adoption of a standard symbol or other response for an element encountered in gross experience and identified by the application of the conventional name, sign or other symbol.

Methods in science teaching. A few psychological experiments have been directed toward the study of the relative merits of various teaching techniques in science. The results vary with the age level, the method of testing outcomes, and with the subject matter. No safe generalizations can therefore be made. The traditional methods are three, so far as science teaching relates to levels above the nature study and geography work of the elementary grades. These are the recitation, the lecture-demonstration, and the laboratory methods. Bearing in mind the complex array of objectives of science teaching, there would seem to be ample place for all these techniques.

Information giving is usually best effected by reading or listening to exposition, especially if this be supplemented by bona fide demonstrations, or faithful film portrayal, as a vital background. Checking up of useful habits, facility in the use of concepts and other symbols may often be best accomplished by recitation, conference or discussion. The actual use and understanding of principles, and also the reënforcement of reading and exposition by vital contexts are clearly capable of being promoted by individual laboratory exploit.

The chief difficulty in all science teaching is escaping the perfunctory. Recitation easily becomes a verbal play; lectures easily lead to hasty and undigested note-taking; laboratory exercises easily become set and formal, undertaken as assignments rather than as live problems.

Motivation in science teaching. Much of the difficulty goes back to that of providing effective motivation. How can arithmetic skill be made to minister to the pupil's distresses and relieve his irritants? The very necessity of much drill for actual mastery introduces trouble to project schemes and purposive-problem methods. Teachers must probably continue to resort to fortuitous and artificial motivation. Fortuitous motives are to be found in the pupil's curiosity; in his distress at failure; in the ignominy of being outdone by others; in the dread of not being promoted; in the embarrassment of not being able to handle larger tasks. Artificial motivation may be devised by introducing projects where possible, organizing individual and class contests, arranging number games. The actually intriguing aspects of mathematics cannot attract the average pupil. But even the simple satisfactions of seeing things work, of proving one's self to have worked correctly, of competing with one's previous record, and the like may be said to be genuine motives of the pupil, even if not in any special way logically relevant to arithmetic.

In other science fields, the close relation of science to daily life, in familiar instruments such as the radio, the motor, and in practical affairs such as the weather, refrigeration, communication, navigation offers abundant contacts for the arousal of zeal and curiosity. In modern schools the educational development of the motion picture has given the science teacher a wealth of material for enriching experience and arousing that very effective irritant which we call curiosity.

Thought controls and science teaching. Aside from the special methods peculiar to each science, certain logical controls to judgment and belief should be emphasized. The essential psychological thing about science is not so much its content as its method. There is no better place to become acquainted with common logical fallacies, the risks of hasty inference, and the confusion of hope with demonstration, than in the courses in science. The common logical fallacies that mar the thinking of the average man seem inexcusable in those who have studied history, economics, and the experimental sciences. Yet superstition, slipshod conclusions and wishful thinking survive, even in those who can recite the lists of chemical elements, the bones of the body, and as well in the thinking of many occupied in teaching.

It would be out of place here to enumerate the array of common fallacies, which the study of science should practice the pupil in avoiding. Affirming the consequent, spurious correlation, *post hoc ergo propter hoc,* question begging, the argument *ad hominem,* and the undistributed middle will suggest some of them. Since, however, arguments offered by leading educators on educational themes abound in just such fallacies, it may be unfair to expect that the teaching of science can teach people to think.

A study of the beliefs of the college students[4] showed a correlation of + .80 between degree of conviction in an array of selected propositions and their rated degree of desirability. Desire rather than evidence appeared to be the determining factor in belief. If science teaching could do nothing more than give the pupil certain specific information (its content) and acquaint him with the laws of evidence and proof, with some practice in evaluating evidence, it could justify its place in the curriculum even if its other professed objectives failed. That it does not do this effectively even with abler students may be due either to faulty methods of science teaching or to the willful perversity of human urges.

Educational measurement in science. Except for such elementary fields as arithmetic, history, geography, there is little agreement on the items of information suitable for any given period of science instruction. Even on the college level, measurement of educational outcomes in the subdivided fields of science has not progressed far beyond the plane of factual examination by the teacher in the things he hoped had been learned. Scales for use in measuring achievement in science are almost exclusively lists of information items.

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[4] F. H. Lund, "The Psychology of Belief," *Journal of Abnormal and Social Psychology,* April, 1925.

Since giving information is but one of the professed objectives of science teaching, development in this field is behind that reached in the measurement of sensorimotor skills and the symbolic arts.

A representative general science test[5] on the elementary school level consists of two parts. Part I gives 50 propositions in the form of uncompleted statements concerning "elementary science facts, principles, concepts, terms, definitions and applications," sampling "a wide range of relatively simple knowledge in the fields of physics, chemistry, astronomy, agriculture, botany, zoölogy and physiology." The correct one of seven alternate terms is to be underlined as the proper one to complete the proposition.

Part II "measures the ability of the pupil to identify apparatus, organisms, structures, and principles and to apply principles of science to the solution of simple problems." Twenty diagrams and drawings are given, each accompanied by a completion exercise based upon it.

The materials of the test are chosen from an analysis of the content of existing books on general science, and the test is designed especially for the 8th and 9th grades. Two forms, of equal difficulty, have been constructed. Reliability coefficients have been determined, and norms are given showing the score reached by various percentages of pupils in schools from twenty-three different states. The test can be administered in one 50-minute class period.

Permanence of learning in science. Few quantitative studies have been made of the retention of learning in the case of science instruction. In Chapter VII a forgetting curve was given showing the retention of information presented in lectures in psychology. After two months the students had forgotten three-fourths of what they knew at the end of a given lecture concerning the items there presented. In many cases such information is acquired by students only for temporary retention, until needed in examinations. Experiments have shown that the intention to remember for longer periods results in a different attitude and technique which to some extent ensures more permanent retention.

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[5] G. M. Ruch and H. F. Popenoe, *Ruch-Popenoe General Science Test* (World Book Co., 1923).

A curve of forgetting for the material or subject matter of elementary botany has been presented by Johnson.[6] An objective, subject matter examination was prepared, based on experience with previous classes. Students were given this examination when beginning a course in elementary botany. The average score was but 5.5 points, out of a possible 298, showing practically no initial knowledge. After three terms of botany this examination was again given, and the average score was 205 points.

The class was then divided into three groups of students, the groups being of equal average intelligence score. The examination was then repeated, at different times in the case of each group. One group was reëxamined three months after completing the course; another group fifteen months after the course, and the third group twenty-seven months after. The scores were as follows, in points on the scale.

	Points
Average of all, at end of course	205
Average of group tested 3 months later ...	110
Average, 15 months after end of course ...	53
Average, 27 months after end of course ...	49

After the first three months, approximately half the items were forgotten; a year later than this (fifteen months after the end of the course) three-fourths of the items were lost. The remaining points, only about one-fourth of the amount achieved in three terms of study, represented fairly permanent knowledge, for after the lapse of another year the score was not materially different.

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[6] P. O. Johnson, "The Permanence of Learning in Elementary Botany," *Journal of Educational Psychology,* January, 1930.

Difficult questions arise concerning the possible equality of the points on such a scale. There is also the question of the relation between subject matter information and other possible results, in outlook and attitude, that may result from the study of a given topic.

In a similar study [7] the retention of information in zoölogy was measured. Scales were constructed to "express attainment in terms of a uniform and consistent unit of measurement." Measurements were made at the beginning, at the end, and one year after, the course in zoölogy, in the case of college students.

After the lapse of a year students were found to retain about three-fourths of the gains in information made by them during the course in zoölogy. The absolute amounts of retention and also the percentages of retention seemed but slightly related to percentile ratings on college aptitude tests. Percentages of retention had little relation to amounts of gain made by individuals, but in terms of absolute amount, those who had gained the most tended to retain the most.

More studies of this character are much needed in experimental education. As such measures become possible, better critiques of methods of teaching science can be afforded. We know at least that items of information once forgotten are not wholly lost. They are more easily relearned than wholly new items would be. Moreover subject matter tests do not disclose all the gains that are hoped for from the study of science, therefore the development of methods of measuring these other outcomes is also desirable.

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[7] J. A. Cederstrom, "Retention of Information Gained in Courses in College Zoölogy," *Journal of Genetic Psychology,* Vol. 38, 1930, pp. 516-520.

PROBLEMS

1. List the usual array of school subjects, in elementary, secondary and college education, and see how successfully you can classify them under the heads Skill, Knowledge, Appreciation. What general suggestions result from this experiment?

2. Does the list of aims or objectives of science teaching differ from a list that might be approved for any other field of instruction? Show by examples.

3. Describe some case in detail to show that mathematics is the symbolic execution of overt manipulation or experiment in the field of sense perception.

4. Observe yourself while mentally multiplying, with your eyes closed, 76 × 89. Describe the experience in detail, noting especially what materials you use, what crutches you fall back upon, and what procedures you adopt.

5. Analyze some other science to show how in its teaching the "aims" or "objectives" are attempted or realized, as is done in the text in the case of arithmetic.

6. Try to make out a list of all the separate and specific habits that must be used in a problem in long division, comparable to those given in the text in the case of addition of a column of two-place figures.

7. Show how scope or sagacity is involved in some other science field, such as physiology, geography, history, chemistry, botany.

8. Describe as well as you can from memory the way in which some specific concept evolved in your own experience and education.

9. Show by concrete example how the three techniques for facilitating abstraction and generalization would be applied in the case of some concept such as heredity, intelligence, pleasantness, acceleration.

10. Find in a book on logic a list of the classical fallacies and become familiar with each through the study of examples. Can you explain the frequent yielding to these fallacies in terms of faulty cue reduction, inadequate scope, and strong motivation?

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CHAPTER XVI

THE ARTS OF EXPRESSION AND APPRECIATION

The language arts. The traditional distinction between action, thought, and feeling is really an abstraction from the concrete facts of life. Actually our activities involve all three features. This is also true of the classical "school subjects." Mastery of a sensorimotor skill, such as reading in its more mechanical aspects, introduces the student to knowledge and invites appreciations and feelings that are an important part of instruction. The sciences are not wholly informational; a sense of wonder, new emotional reactions to natural phenomena, and a quickening and direction of the intellectual and logical feelings—these are more than a mere by-product of the study of science. So also the arts of appreciation and expression are likely to present opportunity for sensori-motor development, for the mastery of specialized techniques, and they become the important avenues of communication through which thoughts and ideas as well as feelings and sentiments are recorded.

Language, in its widest sense, is one of the most extensive and complicated of human activities, and the study of language in this broad sense is one of the chief activities of the school career. It appears first in the understanding of gesture and of aural speech. Then in the acquisition of oral speech—the ability to talk in one's "mother tongue." These are both well developed before the period of school entrance, as a rule.

The earliest school instruction deals with language. The acquisition of reading; mastery of penmanship; the development of a vocabulary; drill in spelling; compliance with the conventional rules and standards of punctuation, grammar, syntax and polite usage require a great deal of explicit or indirect attention. Arithmetic and higher mathematics may be said to represent only a special form of language. Foreign languages, when introduced, complicate the same picture.

In active writing and composition the emphasis becomes still more intensive. Adequate description, narrative, record and communication are here featured, and these imply the presence of ideas and feelings to be communicated or recorded. The expressive arts thus come to be intimately related to the intellectual and emotional life and experiences of the pupil. In the reading program, in composition, and in the general field of literature the simpler and more formal features recede in favor of stress upon the promotion or encouragement of thoughtfulness as well as the development of esthetic appreciation.

The fine arts, such as music, painting, sculpture, drawing, are themselves an elaborate form of language, perhaps more esoteric and calling for more specialized cultivation than the more widely used arts of words and numbers. In the art of creative writing, as represented by poetry, the novel and story, the essay and oration, what one has to say becomes fully as important as the way in which it is expressed.

It is, therefore, obvious that no single chapter can undertake to survey the psychological features involved in the learning or teaching of so complicated an array of activities. An elaborate literature has developed in connection with each topic. We can do no more than select arbitrary illustrations in these fields of some of the more important psychological principles already considered.

Cue reduction in handwriting. Writing, in its earliest stages, requires complex control stimuli. The words are graphic forms, substitutes for speech sounds. The pauses, emphases and inflections of spoken language are rather poorly replaced by the various devices of punctuation. All these responses are conventional—the shapes of letters, the spelling of words, the parallelism of graphic and spoken elements, and the details of punctuation arbitrarily confront the pupil, however long their history may have been.

For the first production of writing, complex antecedents are required. A visual model or copy is needed; to duplicate this with pen or pencil requires long practice in muscular coördination. The word as an oral or aural element must be spoken or thought. In the end, the thought alone, often not even in verbal form, must become a sufficient cue to complicated series of writing movements. Coördinations must be established in terms of "higher units" so that visual control may be dispensed with; muscular sensations from earlier parts of the word become sufficient guides to later movements.

Many "false" movements, and accessory activities, as of eyes, feet, tongue and head are at first involved. Excess energy appears in the gripping of the writing instrument, and in heavy pressure on the writing surface. Details of grouping, alignment and spacing must be reduced to subtle cues, speed must be acquired, and uniformity and legibility achieved.

Such an activity becomes highly organized and easily subject to modification by slight influences. Except for speech and thought there is no more complicated coördination that man develops. Haste, excitement, embarrassment, notably influence penmanship; the style is easily modified by imitation, however unintentional. So easily do subtle factors influence the writing coördination, even when highly perfected, that it is little wonder that people have persistently sought in penmanship for signs of individual character and temperament. No dependable formulations of such relationships in general, however, have been established.

Among the many detailed studies of writing, some have dealt chiefly with its mechanics—the pressure of the writing point and its influence, relations between speed and quality, variations of pressure and speed in different parts of the script, the effect of different amounts and distributions of drill. Other studies have dealt with standards—the speed and legibility to be required, the relative emphasis to be given to speed and quality, the ease and legibility of various styles, the derivation of tests and measuring scales, the formulation of rates of progress to be expected. Still other studies have investigated the favorableness of different postures, writing movements, character of writing surface, and the most desirable order of mastery of the elements. Writing defects, such as "mirror writing," and the changes accompanying mental and nervous disturbance have also been studied.

Many of the outcomes are still unsettled or controversial, or are found to vary with other factors, such as age level, skill level, and the system adopted. There is even in some quarters a reaction against the traditional emphasis on penmanship, a tendency to substitute a printing or manuscript hand for the flowing or cursive type of penmanship, or even to substitute the typewriter for the usual implements. Perhaps the most definite step is the development of scales for measurement and analysis which afford definite knowledge of results and facilitate the correction of defects or weaknesses.

The Thorndike handwriting scale consists of specimens arranged in order of merit and by known steps of advance from a "zero" specimen to a perfect hand. Several equivalent specimens, varying in general type but equal in "quality" are given for each level of excellence. The pupil's score is secured by comparing his writing with the concrete specimens of the scale. Somewhat similar in conception are the scales of Ayres and of Starch.

The Freeman scales provide separate sets of graded specimens for slant, alignment, line, formation and spacing of the elements, thus facilitating analysis of quality as well as a net score for general merit.

As measured by such scales, penmanship in the schools increases rather uniformly both in quality and in speed through the grades. Under prevailing conventions girls excel boys in both features. In children, positive correlations are usually found between handwriting excellence and intelligence, the relation being more noticeable with the relatively dull. With bright children and with adults the two traits have usually been found unrelated.

No very close connection has been found between such variables as posture, position, movement type and rhythm, and the quality of writing. Almost every method may be found in use by both good and poor writers. It may nevertheless be true that some methods are more expedient than others in learning. On the whole, the amount of writing drill in different schools has not been found closely related to the quality of the product, nor have the studies revealed any optimum period or distribution of practice. With respect to the sequence of items learned, various systems of teaching penmanship still differ. Many details on these points can be found in the various manuals and monographs that are published on the subject.

Quality and speed in the case of a given pupil are inversely related. Gates has proposed a formula for a combined score in which the measure of quality is multiplied by the cube root of the measure of speed. Thus measured, the average writing ability of a class remains constant when writing at different rates. Various studies of practical requirements conclude that a quality represented by a score of about 12 on the Thorndike scale or 60 on the Ayres scale, at the rate of about 80 letters a minute, meets practical demands and is usually achieved on the average in the sixth to the eighth grade.

Since learning to write is chiefly a matter of cue reduction and control, actual writing or drill would appear to be the chief method of advance. But in this process it is important to include the related features of learning; motivation for improvement must be secured; adequate models must be provided; knowledge of results and identification of errors must be facilitated; suitable controls must be developed so as to free the process from attentive guidance; higher units of performance than single lines or letters must be established; individual differences must be provided for. However overt and sensorimotor the process of writing, its teaching invites intelligence and scientific procedure.

The psychology of drawing. Drawing serves as a useful example of a "school subject" that is closely dependent on the course of individual development and the level of maturity —two topics which we have seen to be of fundamental educational importance. There are of course various kinds of drawing which differ in certain important respects. Copying, representative drawing, analytical or diagrammatic drawing, impressionistic and symbolic drawing, and caricature may be suggested as some of these. Perhaps they do not equally belong to the expressive arts.

The conception of drawing must not of course be restricted to what takes place in the "drawing class." Throughout the school curriculum drawing in one or another form plays its rôle. Handwriting might even be considered a form of drawing. In geography and history, map making falls under the same category. In the natural sciences, especially the biological sciences, representative and diagrammatic drawings are much utilized. To a certain extent, school achievement depends on ability to draw, and since there is but little correlation between some kinds of drawing and intelligence or linguistic capacity, this is an important consideration in teaching.

Studies of the spontaneous drawings of children show a fairly definite course of development which has been studied in great detail. The following periods are commonly indicated:

1. *Scribbling Stage.* Up to about four years of age the random pencilings become first more purposive, then imitative, then more definitely localized as parts of a pattern. The predominating interest appears to be muscular rather than visual. The activities change as the finer muscles develop.
2. *Stage of Lines.* At about the fourth year, perhaps under the influence of instruction or observation of others, the rhythmic scribbling gives way to the production of lines which appear to represent parts of objects, or their total aspect. But the organization may be bizarre.

3. *Descriptive Symbolism.* At five or six the favorite drawing is of the human figure. Models are seldom regarded, but the "idea" appears to be portrayed from memory rather than as a representation of any object in the field of view. Proportions are often ignored, details omitted, and the drawing may be said to be a symbol rather than a delineation.

4. *Descriptive Realism.* In another year or two the child is found depicting objects by placing in his drawings such features as he knows the objects to possess, rather than what actually appears to view from any one point. Curious syntheses may result; both eyes may be supplied in a profile, the legs are seen through the garments; perspective is neglected; decorative details begin to appear.

5. *Representative Realism.* From nine to ten years drawings become more truly representative, and an effort is made to portray the actual appearance of objects. More critical concern is felt for arrangement and perspective, and indications of action and movement are attempted. Technique improves rapidly, and there may appear elements of dramatic character in scenes and situations.

6. *Period of Repression.* Through the period of puberty the pupil often becomes critical of his attempts, as he begins to compare them with superior models. Even those skilled in the art may become discouraged or lose interest. Those lacking in the ability tend to drop it from their activity and turn to other interests.

7. *Period of Revival.* During adolescence those particularly endowed show a reawakening of interest and drawings may now come to approximate high standards of achievement; they are often made to tell a theme, and interest in draughtsmanship and the elements of design may appear.

Development in drawing reflects the total development of the individual, rather than the unfolding of a special graphic impulse. Thus, the drawings of the feeble-minded afford a neat picture of the mental make-up of their makers. In firmness of line, and in features dependent on experience of the world these drawings may be considerably advanced. In other respects the drawings may be inferior to those of normal children of the same age. The net outcome gives a strange product that strikingly suggests the profile or mental pattern of such individuals, who are far from equally backward in all aspects of their development.

Studies of representative drawing have shown it to be by no means closely correlated with intelligence. Good drawings may be produced by pupils whose work in other fields is definitely inferior, and excellence in the drawing class is no guarantee of "mental ability" or "brightness." Nor is lack of ability to draw a sign of dullness. In the case of diagrammatic and symbolic drawings the correlation appears to be much more close with intelligence.

While facts of this kind throw little light on the teaching techniques for drawing, they represent relationships which the teacher of drawing, as well as of other subjects, can usefully bear in mind. Indeed, the failure of representative drawing to correlate with general intelligence might even lead to the modification of teaching techniques and standards of performance in other fields, such as the natural sciences.

Motivation in the expressive arts. Another fundamental principle of learning, along with cue reduction, we have found to be motivation. Because of the arbitrariness of many of the elements of the language arts, it is often difficult to secure intrinsic motivation for their perfection. When ungrammatical speech secures results with playmates, and when precise diction may even invite scorn from them, motivation for mastery of such matters as inflection, diction, and grammar must be secured somewhat indirectly. When a poorly written letter conveys one's meaning reasonably well, and no immediate irritant is removed by correct punctuation, very remote or somewhat artificial ends must be advanced to make drill productive.

The ordinary schoolroom techniques of grading, promotion and class distinction have their place until the individual's own ambition finds some connection between these matters and the life career or the social status. Only quite intelligent pupils find linguistic matters intrinsically interesting, and these are the ones who are least in need of drill. The correlation between work in vocabulary, composition, and grammar with intelligence as measured by tests is very high. This does not mean merely that such items are likely to be much used as the material of intelligence tests. The essence of language is its symbolism, and this, as we have seen, is also one of the essential features involved in the definition of intelligence.

Language "games" are often resorted to in the lower grades, just as "spelling bees" were once used to stimulate interest in that aspect of the language arts. Competition for honors in writing, writing for class reading, for the school paper, and similar procedures which closely relate the technique of expression to the individual's conception of self have their merits. So also does emulation of a model, encouragement in the reading of masters of style and eloquence. The technique here as elsewhere is that of finding or providing some irritant or dissatisfaction which only the mastery of linguistic skill will alleviate. Since the linguistic rules are to so considerable extent arbitrary or conventional, little can be expected by way of teaching general principles from which the specific habits may be derived. We learn to speak by speaking, to spell by spelling, to write by writing, and perhaps to think only by thinking.

Because interest and ability therein vary so widely, nowhere is there greater call for teaching adapted to individual differences, for individual guidance and directed study, than in the field of the expressive arts. In such special fields as drawing and music there is even good argument for wholly excusing from the activities those not natively interested or able in these fields, beyond that elementary level which may be required to make sure of individual differences and to afford whatever capacity for understanding and appreciation may be expected from the average pupil.

Because of the limitations of deductive learning in the expressive arts, a favorable method of instruction has taken the form of "error prevention or correction." To show a pupil to be "in error" is apparently a useful irritant and motive to improvement. Moreover, the analysis of individual errors makes it possible to make teaching more specific and to distribute attention in a maximally effective way. Many studies have therefore been made of the frequencies of various types of error, or specific mistakes, on different educational levels. On the elementary levels familiarity with these tabulations facilitates the planning of a program in language, speech and writing.

Motivation is also better provided now that standard scales for the measurement of various linguistic achievements have been devised. These afford the pupil an objective rating of his status, as compared with others, and as compared with the general norms, and this may afford a suitable incentive toward self-improvement, as well as knowledge of results and a definite program of achievement.

The influence of experience on composition. We have illustrated cue reduction in the case of handwriting; the topic of motivation in connection with all language study; the importance of scope in this field has been in earlier chapters frequently illustrated in connection with reading, spelling, and arithmetic. Another important topic for learning we have found to be background or vital experience. Without an initial experience, drill is futile, and progress cannot be expected except on a purely perfunctory or rote plane.

The importance of vital experience in education is neatly illustrated in connection with the subject of composition, in a study by Hudelson. Children from grades VII to XII were asked to write compositions on assigned topics, these having been specially selected in various ways for purposes of comparison. The compositions were rated for merit by eight judges, and a study was then made of the relation between character of topic and excellence of the compositions.

The nature of the topic was found to exert an important influence on the quality of the composition. The general result was that topics on which the pupils already had a background of personal experience produced more excellent compositions. "Did It Happen Right in Church" produced compositions much inferior to "A Story Based upon a Picture." The compositions on "An Argumentation on School" were much inferior to those on "A Description of Camping." Similarly "An Interesting Story which You Have Heard" resulted in compositions inferior to those on "The Most Exciting Ride I Ever Had" or on "How I Learned a Lesson."

Expression, in other words, should take for granted that there is something to express. Composition excellence is greater when the materials of experience are ready, calling for utterance. There is therefore a real distinction in effect between the method of teaching composition which requires that the pupil first conduct a second-hand investigation, and thereupon write about the topic, and that method which takes the individual's first-hand experiences as the subject of expression. Since we learn to write well by doing so, rather than by fumbling and halting on the way, it would appear desirable that composition as a technique be closely tied to the report and communication of first-hand experience, and only when reasonably established be turned into an instrument of research.

It is in such connections that the project method and the purposive problem may find a justification in the field of the expressive arts. The more closely the expressive activities are related to the immediate life of the pupil, the more strongly motivated will they be, and the higher the level on which habit formation will be fixed. It is perhaps for such reasons that the first writings of even the professional author are so likely to be semi-biographical in character.

Limitations of creative expression. The close connection of language with thought and the positive correlation between the use of symbols and the general "quality of the organism" justify the rather modest aims of common school education in the expressive arts. Thus in the case of written composition, the objectives set by the National Joint Committee on the Reorganization of English in the High Schools were the abilities—

(a) To write a courteous letter according to the forms in common use (*b*) To compose a first draft, a clear and readable paragraph or series of paragraphs on familiar subject matter

(*c*) To analyze or present in outline form the gist of a lecture or piece of literature

(*d*) To plan and work out, with due time for study and preparation, a clear, well-ordered and interesting report of some length upon one's special interests

(*e*) To write a short story or other bit of imaginative composition (in the case of those who have literary tastes or ambitions)

These objectives imply clearly enough that only the gifted will achieve the higher reaches of creative writing. This recognition accords with what little we know about creative ability. On the basis of uncontrolled experiments, with highly selected pupils and especially gifted teachers, those responsible for the conduct of language arts in the schools have sometimes been reproved for the formalism of their methods and the banality of their standards. Youth, it is asserted, is fundamentally creative and expressive; if only "the lid is kept off" and provocative guidance given, it is urged, the typical high-school pupils will be found to be bubbling over with sonnets and madrigals and eager to perfect the elements of artistic workmanship. Selected poems and other compositions by a few children in the extreme upper ranges of intelligence have been submitted in proof of such claims.[1]

That an occasional "mute inglorious Milton" becomes deflected to other than literary interests may be granted. We have much to learn also about the conditions and processes of creative ability in every field. What little we have learned shows clearly that a high order of general intelligence is requisite for creative work in any of the expressive arts; that expectations of creative fervor on the part of average high-school pupils, already a selected group, are doomed to disappointment; and that creative ability, when it appears, has very little relation to the special methods that have been responsible for its instruction. In this as in other fields of creative accomplishment, however, it must be said that the psychology of our day has much to learn and little to contribute. Behind the techniques of expression lie the art of thinking and the life of feeling, regions which still await thorough exploration by the methods of controlled experiment.

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[1] See, for example, Burks, Jensen and Terman, "The Promise of Youth," p. 362, *Genetic Studies of Genius*, Vol. III (Stanford University Press, 1930), for information concerning the intelligence quotients of the writers of the selected juvenile poems presented in H. Mearns, *Creative Youth* (Doubleday, Page & Co., 1926).

The psychology of music. In the arts, as elsewhere in human nature, it is a general rule that appreciation precedes execution. Many who are capable of enjoying a drawing, an oration, or a piece of music are wholly incapable of producing it, or perhaps even of learning to produce it. Partly for this reason, and partly because of the intensive specialization of modern life and the ease of communication and travel, there is a growing tendency to neglect the active side of the fine arts, and to rest content with the rôle of spectator or auditor. The desirability of this trend might well be questioned; but in the case of music the present tendency is conspicuous.

The psychology of music is far from understood. Even the physiological basis of sensations of tone is a matter of debate and conjecture. On the sources of our reactions to and interest in melody and harmony there are many theories. It appears to be reasonably clear, however, that there is no single entity that might be called "musical ability." Musical appreciation and performance are very complex resultants of many contributing factors, some perhaps innate, others definitely a matter of experience and training. Seashore offers the following analysis of at least some of the factors involved in musical talent, without respect to any special form which it may assume:

I. Musical Sensitivity
  A. Basic capacities
    1. Sense of pitch
    2. Sense of intensity
    3. Sense of time
    4. Sense of extensity

- B. Complex capacities
    - 1. Sense of timbre
    - 2. Sense of rhythm
    - 3. Sense of consonance
    - 4. Sense of volume
- II. Musical Action: Natural capacity for skill in accurate and musically expressive production of tones (vocal or instrumental or both) in
    - 1. Control of pitch
    - 2. Control of intensity
    - 3. Control of time
    - 4. Control of timbre
    - 5. Control of rhythm
    - 6. Control of volume
- III. Musical Memory and Imagination
    - 1. Auditory imagery
    - 2. Motor imagery
    - 3. Creative imagination
    - 4. Memory span
    - 5. Learning power
- IV. Musical Intellect
    - 1. Musical free association
    - 2. Musical power of reflection
    - 3. General intelligence
- V. Musical Feeling
    - 1. Musical taste: likes and dislikes
    - 2. Emotional reaction to music
    - 3. Emotional self-expression in music

Such an analysis serves to indicate the complexity of the problems of learning and teaching in the field of music. For general purposes in education it is important to know that there is much evidence that these musical attributes of personality represent native and presumably hereditary features, in which individuals differ widely. Many of these, such as the elementary capacities for appreciation of pitch, have been shown to be scarcely susceptible to training in the ordinary sense.

Musical talent and interest also appear to be relatively independent of general intelligence, so far as basic endowment is concerned. It is, of course, true that musical accomplishment of a high order requires a fortunate combination of both traits; but the presence of one is no guarantee of the other. Methods are now being developed which will make it possible to diagnose the presence or degree of musical capacity as a complex resultant, or in certain of its requisite elements. In no field of general instruction are such methods likely to be so generally useful as in the field of musical education.

Measurement in the expressive arts. Only a few of the many language scales and similar standards may be described briefly, to indicate their general character. In one series (Charters) of language and grammar tests there are provided lists of sentences to be corrected. The pupil may also be required to state the rule of grammar violated or illustrated. Standard scores of the grades are provided as a background on which either the individual or the class performance may be measured.

Composition scales (such as those of Hillegas, Hudelson, and others) more commonly resemble the scales for handwriting in general construction. Specimen compositions, sometimes on the same theme, are provided, these having been judged in various ways so that their merit can be stated in terms of equal steps on the scale. The pupil's composition is scored by comparing it with the actual specimens of the scale.

In grammar scales (such as those of Starch) the material consists of sentences containing correct or incorrect forms; the pupil's task is that of identifying these as correct or not, and groups of increasing difficulty provide a means of measuring the range of the pupil's knowledge. Punctuation scales based on the same plan are also provided by the same investigator.

The Trabue completion test language scales illustrate another method. Sentences are provided from which certain words have been omitted. The pupil is to supply the missing word so as to make the best meaning. The sentences increase in difficulty, and different scales are provided for different general levels.

Various forms of vocabulary test are also in common use.

Perhaps the most familiar is the Terman vocabulary test which presents 100 words, graded in difficulty, so chosen as to sample the contents of the dictionary. The pupil is required orally to state the meaning of each word, and is credited with all his successes, according to definite rules of acceptance or rejection. The test is scaled on an age basis, and the scale is felt to be one of the most useful hasty methods of indicating a general mental age level.

Scales for the measurement of drawing ability have been devised in various forms. Some relate to mechanical drawing and lettering, others to representative drawing. An interesting one is the drawing scale of Burt, in which for each level a drawing of a man is given, which represents the median achievement of children of that age. The pupil's drawing of a man can easily be approximately equated with one of the specimens, and his "drawing age" thus indicated, so far as this achievement is representative.

In the field of music the best known tests are the Seashore Tests of Musical Talent, which have been reproduced on phonograph records for group use. Measures of the individual or class in pitch discrimination, sense of time, intensity, tonal memory, tonal consonance, rhythm may be secured, and norms for age or school grade afford a basis of comparison with the achievement of pupils in general in the same tests.

In the fine arts attempts to provide similar scales are under way. The Meier-Seashore tests and the McAdory tests are excellent examples. Pictures of designs and arrangements are provided, from each set of which the pupil is to select the one most satisfactory. The judgment of professional artists or the character of classic models is used as a standard by which to rate the individual's conformity to the verdict of the expert.

Similar or related tests and scales have been proposed for other types of execution or appreciation—for the appreciation of simple designs and arrangements of lines, for the appreciation of poetry, of musical selections, and even for the measurement of the sense of humor. One of the chief advantages of scales of these kinds in the general field of the expressive arts is that the pupil's advance and rating therein need no longer be wholly contingent on the inspiration or personal whim of the individual teacher. Standards of achievement come to have more than a local significance, and to this extent at least acquire a more objective character.

PROBLEMS

1. Ask a young child to copy a specimen of handwriting and observe, in the behavior and the product, some of the characteristic sources of difficulty.
2. Practice writing your name ten times with the hand not usually used; note the initial difficulties and the nature of the changes with practice. Practice an unfamiliar hand, using a specimen as copy. What new difficulties are encountered?
3. Secure a Thorndike or Ayres handwriting scale, and rate a few specimens of penmanship secured from classmates.
4. Draw a picture of a man, using a pencil; do it as well as you can; then rate your product on the Burt or the Thorndike drawing scale, if either is available.
5. Observe random samples of drawings collected from children of different ages, noting the degree of correspondence to the developmental scale outlined in the chapter.
6. Secure specimen compositions from school children and rate them, using one of the available composition scales. Discuss the questions that arise in connection with this project.
7. Try some of the Seashore music tests, or let them be briefly demonstrated to the class.
8. If either the Meier or the McAdory art test is available, secure your own score on it, or let the general character of the test be demonstrated by samples.

Price lists covering many varieties of materials, tests and scales such as those here referred to may be secured from the Public School Publishing Co., Bloomington, Ill.; Teachers College Bureau of Publications, Columbia University, New York City; and World Book Company, Yonkers, N. Y.

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CHAPTER XVII

EDUCATION FOR MENTAL HEALTH

"Concomitant learning" of many kinds should accompany the mastery of specific skills and the acquisition of information provided by the curriculum. Many educators believe that these "by-products" of organized activities are the most important contribution the school can make. Among them the following may be indicated:

(*a*) A problem solving attitude, with habits of reflection, initiative, experiment, and the tendency to demand the proof of conclusions before accepting them at face value
(*b*) A socialized attitude, which accommodates a self-interest to group aims and gives to the activity of the individual a wider outlook than that easily achieved by the uneducated
(*c*) Desirable character traits, such as habits of industry, truthfulness, honesty, coöperativeness, a sense of fairness, tolerance
(*d*) A better integrated self or personality, in which emotional balance and rational control develop, with no loss of enthusiasm

The road to such achievement is a long and hard one. It is, moreover, uncertain to what extent school experience can counteract other influences, such as those of heredity, home relationships, social experiences outside the school, which often work in undesirable directions. The chapter on mental hygiene is usually the most banal section of any textbook, partly because of the difficulty of offering broad generalizations on topics so complexly involved in devious special and individual circumstances.

Certain general points may however be suggested which seem to be relevant to mental health. They may be considered tentative objectives in an individual program for the cultivation of personal balance. With such a program in mind, teacher and pupil may be aided in smoothing the course of school activity and perhaps in making more certain the concomitant gains that education aspires to contribute.

Appraise the self honestly. How can one know oneself? Subjective estimates are often unreliable. We rate ourselves higher in desirable traits and lower in undesirable ones than the consensus of opinion justifies. Every individual has limitations; it is better to know and frankly admit them than blindly to cherish the delusion that every soul has infinite potentialities. One can scarcely modify his stature, his intelligence, his sagacity, his capacity for learning, his color blindness, his sense of pitch. To aspire to do so is only to invite frustration and distress.

A frank inventory of the self is the first step toward mental health. Seek objective standards; welcome tests that give reliable information. Honestly face the motives, the interests, that seem to be operating, and inquire whether they are genuine or only pretended and borrowed. Do not by any means cease to wish and to aspire. But let aspiration be tempered to the facts, rather than the facts be colored by the aspiration.

> Brutes find out where their talents lie.
> A bear will not attempt to fly;
> A foundered horse will oft debate
> Before he tries a five-barred gate.
>
> But man we find the only creature
> Who, led by folly, combats nature;
> And where his genius least inclines
> Absurdly bends his whole designs.

Cultivate an objective attitude. Overvaluation of one's own importance is probably a necessary feature of achievement. Without a firm conviction in the truth of one's beliefs, the seriousness of one's efforts, the significance of one's symptoms, the ardor of endeavor and the satisfactions of illness are measurably reduced. But an impersonal view of the situation will help to avoid chagrin and soften the blow of failure.

It is wholesome mentally to "see ourselves as others see us." Self-pity is one of the worst poisons to a personality. Self-pity tries to exact of the world at large the same concern that the individual feels for himself. Others, wrapped in their own self-pity, fail to lavish the expected coddling. The victim easily develops an extravagant sense of injustice, and the life of delusion begins.

Get then an occasional distant perspective of yourself; see how your aches and disappointments, your wishes and tender spots, appear to a man on Mars, or even to the man across the street. It is not necessary to become cynical; for a cynic's views are deep-dyed with an unrecognized personal reference. But a frank appreciation of the unimportance of one's own "feelings" as an episode in the history of the world will do much to reconcile one to his fate, without necessarily killing new hope and effort.

An impersonal and objective view of things, and especially of one's self, is as conducive to achievement as to consolation. The adolescent girl who walks down the aisle full of the belief that all eyes are fixed critically or appreciatively upon her becomes awkward rather than graceful. Even the loss of one's fortune is of little concern to the wide world. Nor is the world exclusively occupied with thoughts about one's inferiorities, blemishes, or embarrassments. If anything, the world rather enjoys them. If you can see the humor of them yourself, you have made good progress toward an objective viewpoint, and your mental health is likely to improve.

Meet reality face to face. There are several ways of encountering reality. One is to turn tail and retreat into an inner world of phantasy; there one can in daydreams receive adoration and affection, be important and commanding with little pains. Or one can face reality indirectly, by subterfuge; can be blind to some of the facts and put a false face on others. Either mode of evasion is unhealthy, if too much indulged. If overindulged and chronic, these become the pattern of such psychoses as paranoia and dementia præcox.

The healthy way to meet reality is to face it—even to attack it if it offers vulnerable points. If you are incompetent, admit it, rather than project the blame upon the teacher, the principal, or the social system. If your children are grown up, or are feeble-minded, or are brighter than you, why longer baby them; why blame the doctor; why bolster up your pride by sarcasm and bitterness? Face the facts, and then see what can be done about them.

A reasonable amount of phantasy is normal, and is in a sense the ordinary technique of thoughtful planning. But in the useful form, phantasy is occupied with methods, with solutions, with steps to be taken. It is the phantasy that dwells exclusively on fancied outcomes that is infantile and regressive.

A stuttering child can meet reality by daydreams of eloquence, while his lessons go undone and his speech defect remains; this is phantasy. Or he can meet it indirectly by stubbornness, general negativism and resistance to all projects initiated by others; thus he expresses himself without speech; but this is evasion. Or he can become overoccupied with nonvocal pursuits, develop athletic frenzy, or a passion for drawing; this is compensation or sublimation. He can avoid social situations with the excuse that they are trivial, uninteresting, not worth his while; this is rationalization. Each is only a makeshift, and a more permanent and healthy solution is to be found only by direct attack upon the source of distress, which is a reality.

Avoid mental limps. A limp resorted to while an injury is healing is justified by its stimulus. But such limps may persist long after the original justification has gone. The mere feel of the shoe, a reduced cue, may now serve to provoke the useless and handicapping irregularity in one's gait. It then becomes a mental limp, without due control by other cues of the present situation. It is therefore a neurosis.

Phobias, obsessions, fixed ideas and morbid feelings may have a similar origin. Once justified by a severe occasion, they are perpetuated as mental limps in situations no longer calling for them. Antipathies, aversions, prejudices, may become deep-seated and persist for life, and yet be only mental limps. They may reflect only the biography of the patient rather than the character of the situations to which they are now related.

To cure a mental limp, first discover what the cue is that produces it. What is it in the present situation that arouses your dislike or suspicion? Having found this cue, what are the past contexts for which it now functions? Bring these clearly to mind and discover whether the cue alone justifies the aversion, or only its former contexts. Then examine the present situation. Are the other elements also demonstrably present, or only the single cue? If the latter, it will be found that this very analysis tends to substitute a judgment, a memory for the original aversion. The *affective* response has been displaced by an *intellectual* judgment. The cue has been retrained to a new response.

Stage fright is a familiar example. Some detail of an audience situation often operates as a cue for a former distress that may not even have been connected with an audience. The cure of stage fright may often be accomplished by just such an analysis as we have described. But the main thing is to know a mental limp when you have one, and not to attribute it vaguely to an "instinct," to your "heredity," or to your delicate and sensitive make-up. If you have a mental limp, you are a cripple.

Emotions are signs of distress. Be calm. Instead of priding yourself on your emotionality, realize that emotions are always signs of impending collapse, trivial or grave. Emotions are disturbances that arise when no ready adjustment of thought or action is at hand. They may be signs of conflict between action tendencies that are evenly matched, permitting lower order responses to take their place. A typical picture of emotion is that of the robin, confronted by a man, on a porch where its nest has been built in his absence. The bird tries both to retreat and to advance; the conflict of these tendencies results in the picture of squawking and restless distress which is the emotion.

Emotions organically are primitive emergency devices. The internal organs, the lungs, heart, glands, blood vessels, behave so as to produce quicker coagulation, readier supply of muscle fuel, massing of circulation in arms and legs. Even organically there is the recognition of emotion as a crisis. Part of the same picture is withdrawal of circulation from the trunk, impeding of digestion, interruption of the orderly flow of thought.

In modern life, two features of this are important. Modern emergencies are seldom to be met by overt muscular attack. The organic adjustment is a vestige and a handicap. Emotional outbursts result in personal disaster and unfitness, rather than in effective attack, except possibly in face-to-face combat with beasts, which is a rare emergency.

In the second place, emotions are easily transferred—aroused by subtle cues in situations which do not justify them. They thus become habits, learned reactions of maladjustment, and chronic modes of collapse. Emotionality therefore is a symptom of weakness, rather than a sign of health. Since emotions are so easily transferred and trained to subtle cues, the technique of emotional adjustment is not medical but strictly educational.

Mental health demands repression. The course of normal development is one long series of inhibitions. Lower order adjustments come to be subordinated to the control of better techniques. Only when random and "free" eye movements become harnessed in the interests of clear and single vision, can the visual world be usefully explored, and such a useful act as "reading" take place. Only when the simple "grasping reflex" becomes overlaid by more serviceable habits of the voluntary sort, does manual activity serve safe and useful ends. Beyond the simple vegetative processes, repression of the spontaneous and involuntary by the deliberate and restrained is the rule of development.

Growing up consists in part of just this imposition of inhibition and suppression upon the native and unorganized action tendencies, as thoughtful consideration supervenes upon unreflective impulse. A silly sentimentalism, often masquerading under the name of "psychology" has in recent years turned the heads of many parents and educators and blinded them to the important truth that mental health demands repression.

It is in fact the *failure* of repression that serves as the sign of mental breakdown. The doctrine that children should freely live out their spontaneous urges, for fear of producing repression, is only a play to the half-educated gallery. The doctrine that repressed urges cause havoc in the personality is another error. It is instead the half-repressed, the ineffectually controlled urges that conflict with one another, and with the life of reason.

The cure for disturbances due to ineffective repression is not less but more control. Control, as we have seen, is always due to coöperation of stimuli. The essential point for mental health is that the controls should be such as can be relied on, such as will be available when needed. They should be ideas, considerations, purposes, conscious rules of conduct, in the personal repertoire of the individual, rather than fortuitous commands and threats originating now and then only in the speech and conduct of others. They should, as soon as possible, become inner rather than outer controls.

Happiness depends on irritants. Complete absence of stimuli, even monotony of stimulation, puts us to sleep. In the absence of irritants, human complacency becomes apathy. Pleasure is the name for the removal of a distress. Happiness is due to a repertoire of action that meets distress with a ready technique of solution. Without the distress there would be no solution, and without the solution no satisfaction. The way to happiness, therefore, so far as this lies in the power of man, is the development of a problem-solving attitude and an equipment of skill and information that enables this attitude to function when problems arise. All that is then required for happiness is problems.

The obvious motto for education is therefore to train the pupil to do things for himself. To so pamper the child that he has no problems; to solve every problem for him at its early appearance is not training; it is the theft of satisfactions. That way lies only apathy and self-pity for the individual. Problems can even with profit be invented for him, and in the ready-made life of the modern city child this is often necessary.

Even adults often fancy that when all their problems and distresses have been met they will settle down to a life of pleasure and happiness. The experience of mankind is against them. They are more likely shortly to feel the need of distress, and neurasthenia and hypochondria achieve this for them. Mental balance in later years can best be achieved by following the psychology of youth. Collapse can often be prevented by supplying the self with a thread of interest, an avocation, a project, in which ever recurring distresses or problems may continue to be met with techniques of solution, and with the resultant satisfactions.

Cancel your denominator. The value of a fraction may be increased as easily by reducing the denominator as by multiplying the numerator. Human beings are just such fractions. The denominator is their expectation, their demand, their picture of their needs. The numerator is their heritage of capacity for the achievement of pictured satisfactions.

Much of human misery and of social maladjustment arises from the fact that men are more alike in their appetites and cravings than they are in ability to satisfy these demands. Individual differences in intellect are greater than those in physique, physiology, bodily distress, and the array of common irritants.

The social problems arising from this fact we need not here discuss. But for the mental health of the individual the way is obvious. A bankrupt can improve his condition more safely by decreasing his overhead charges than by increasing his resources or borrowing from others. In fact, Janet, a famous specialist in mental disorder, has described the state of many invalids as one of "nervous bankruptcy."

Parents whose boy has an I.Q. of 100 can promote their own mental health appreciably, and that of the boy enormously, by abandoning their firm intention to "prepare him for Princeton." The ordinary woman, married to an ordinary husband, but wedded also to the extraordinary aspiration to be a social idol and a patroness of the arts, can help herself measurably by decreasing her denominator. Galton's "law of regression," which showed the tendency of offspring of exceptional parents to be less exceptional than those parents, should be understood by every educator. It can often be used to reduce painlessly the denominator of fond parents who expect all of their children to accomplish more than their parents did. The peace of mind that comes when one, once and for all, renounces the hope of being a superior athlete, a subtle diplomat, a distinguished poet, a beau ideal, a captain of industry is at least a step in mental hygiene to which any harassed soul may look forward.

The point is not that ambition is to be discouraged, either in the young or the old. Ambition is an effective distress, but it can be relieved only by enlarging one's numerator. If this technique fails, mental health may still be achieved by attacking the denominator. For many pupils, misled by commencement eloquence and the advertisements of correspondence schools, the most promising thing is to attack the denominator at once. Teachers can be useful, through educational guidance and vocational information, in assisting pupils to keep their denominators from assuming bizarre proportions. The adjustment of reasonable denominators to existing numerators is the aspect of democratic education that can stand most securely.

The saving grace of skepticism. No better tonic for mental health exists than a degree of skepticism that rejects fads, propaganda, and pronouncements of the pompous until the evidence, supported by control data, is made available. Credulity is native to the human mind; supported by wish fulfillment it is well-nigh irresistible. That nature is compensatory; that the good will die young; that the bright will deteriorate; that quick learners have a poor memory; all these are propositions that can be glibly pronounced. Their import also tends to relieve a typical human wish. The care exercised in the preparation of books, and the authenticity of texts goes only to confirm the tendency to accept whatever proposition is seen in print. The advertisements take plain advantage of this credulity.

But it happens that mental health is easily disturbed, and vain endeavor and superstition encouraged by such credulity. If the teaching of science in the schools, the technique of experiment, the method of inquiry, the procedures of proof, could only be so established as to transfer outside of the classroom, no other argument for science training would be needed. That science teaching does not succeed in dispelling native credulity and replacing it by a healthy attitude of inquiry seems fairly clear.

At least, the teacher can welcome a skeptical attitude when some pupil naturally endowed with it appears. It may be that such an attitude, which distrusts assertions made on inadequate grounds, is chiefly a matter of intelligence. In this case our paragraph should be headed "the saving grace of intelligence."

Intelligence and mental health. Even if intelligence cannot be increased in the individual, it is important to recognize its close relationship to mental health. Studies of the bright show them to be emotionally better balanced and controlled than the average. Resistance to the disturbing effect of drugs experimentally given is greater in the more intelligent. Studies of neurotic conditions, such as hysteria, neurasthenia, and constitutional psychopathic state show these cases to be drawn largely from the intellectually inferior. The greatest number come from the large group of the dull, who escape feeblemindedness but fail to achieve the normal level.

Techniques of mental adjustment and psychotherapy are found to depend for their success on the intelligence of the patient. It is this same factor that makes some human beings less likely than others to succumb to mental distress, and more prompt to regain control if once they have been overcome.

Cultivate adaptability to insecurity. Mental collapse is often the result of experiences that disrupt a settled attitude of routine and introduce elements of uncertainty, suspense and insecurity. Human affairs are never secure, and a mental attitude built up in this expectation is almost certain to suffer. Nothing is, in fact, more likely to encounter shock than a life that settles back on the assumption that things are now arranged. They never are. The struggle to achieve relative security is one of the greatest drives of human action. No one is better fitted to engage in that action than one whose sense of insecurity is keen.

A coddling pedagogy has often suggested that every effort should be made to promote in the child the delusion of security. It is contended that such a feeling will give him self-assurance, confidence, and enable the ego to expand more generously. It is clear at least that the delusion of security is a poor preparation for life. Well-known types of neurotic breakdown represent people whose sense of security has been so chronic that any violation of it invites an attitude of profound self-pity, in which the world is expected to share. Since the world seldom does so, the sickly pedagogy that encourages this self-complacent and egocentric attitude may be in part to blame for the calamity.

Mental health is promoted by a calm readiness for approaching emergency. Even the planning of techniques in advance of fancied emergencies has its merits, when it does not encroach upon an active participation in the events of to-day.

New habits for old. Biology teaches no more significant lesson than that organs which once served a useful purpose may survive that need, only to become a handicap. We find it healthy practice to revise our bodies, to get rid of our tonsils, our wisdom teeth, our vermiform appendices. These are apparently vestigial organs, hangovers from an earlier day when they promoted adjustment. Now they are often a danger instead.

Human habits, likewise, once established, may outlast the need that gave rise to them and menace mental health. A constant readiness to revise our habits, refusal to be an old fogy, is often the only salvation. Education, once accomplished, must be often renewed. The songs we learn go out of date; friends disappear; foods and garments change, and ways of living alter; children grow up and assume their own responsibilities; new instruments and appliances replace the old. Unless one is to become an antique, one's habits must keep pace with life.

Even the "facts" of science change. The chemistry, the physics, the geography, and the history we once mastered, become as quaint as baby talk, the hoop skirt, the side saddle, the hitching post. So also with human relations and the habits they invite. Habits of deference, appropriate to childhood, may mean personal failure if prolonged into adult life. Habits of thrift, perpetuated beyond the occasion that first justified them, bring a petty inner comfort at the cost of larger satisfactions. Habits of dependence, proper enough to youth, fail to function when the supports of home give place to the jostling of strangers. Childish play must give way to adult habits of work. Adult work habits, in turn, scarcely dare become habits; they in turn must often give way to other work habits. Parental attitudes of nursing and directing, not revised when the nurslings mature, may foster resentment rather than devotion, despair rather than pride.

Adaptability is as necessary for the old as growth is for the young. Dismiss the fancy that when you are "grown up" you will be made; that once you have been "educated" you will be complete. Think of education as only a way of life, an improved technique of acquiring new habits. Meet a changing world with a personality that is flexible when the world requires it. You will miss your old habits, just as you may regret to see the old ways change when you have got well set to live them. But life these days is that way, and the readier you are to revise your habits when the occasion justifies, and the quicker you are to see when this is the case, the longer you will remain educable. The longer you remain educable the calmer will be your emotional life, and the healthier your mental adjustment.

Learning ability, as we have seen, declines with age. How much of this decline in tests is due to an indisposition to learn and how much to sheer inability, it is difficult to tell. At any rate, learning ability even as measured, remains high in adults, high enough to make habit revision possible if desired. The modern movement for adult education may be said to be a public recognition of the importance of flexibility in grown-ups.

Learn to walk alone. There are several reasons why mental breakdown is more common in modern life than under simpler conditions of existence. Standards of mental balance are higher; lighter forms of inadequacy have more serious consequences; there is less elimination of the unfit by the rigorous process of natural selection; the stress and strain of competitive existence may have an effect; the submergence of the individual by the crowd makes it more difficult to achieve a satisfying feeling of self-importance. But a further factor, to which insufficient attention is paid, is the attitude of dependence fostered by modern life.

Increasing specialization and division of labor make each of us economically dependent on the production and good will of others. The prolongation of infancy makes youth dependent for about one-third of life on parental support. During the last third, in turn, many parents are dependent on their children. Prolongation of contacts, mutual economic dependence, expectation of fond allowances and tolerance come easily to mean emotional dependence also.

Every healthy mind requires emotional weaning from the family. Without such adjustment youth suffers from chronic infantilism. Not only will it suffer when home attachments are eventually broken; it will come to expect from the world the solicitude hitherto accorded by parents and doting relatives. By weaning is not meant that affection and mutual regard should be lost. What is meant is that each individual's mental health is promoted by emotional independence and by an emotional freedom that permits of new attachments on their own merit, not as substitutes for the parent.

Emotional independence of the children is as important for the health of the parent as for that of youth, for this is also likely to mean emotional integrity on the part of the parents. The mother who "cannot bear" to see her children become adults and set about their own careers and homemaking in their own ways and places is the one who is most likely to exhibit a nervous breakdown when the event is finally forced upon her.

It is significant that it is so often the mother rather than the father who breaks down with functional collapse in middle life. The correlation of this phenomenon with the occurrence of the menopause is a myth, unsupported by evidence. It is at about this time in the mother's life that the children are ready to leave home for school, for marriage, for career. The emptiness of life when this occurs bears witness to the unhealthy degree to which prolonged attachment to offspring may unfit the parent as well as the child for emotional independence. In the absence of economic or other occupation, absorption in the children comes to be more conspicuous in the case of mothers. The father's mental health is preserved by his independent vocational career, its vicissitudes and successes.

Mens sana in corpore sano. No enumeration of the principles of mental health, however partial, should omit the consideration of physical health. Although the rules for physical hygiene are scarcely more specific than those we have just suggested for mental health, the comfortable mind can scarcely evolve in an uncomfortable body. In so far as bodily comfort and physical tone can be improved, mental balance may be promoted.

Indication of the useful steps that may be taken to discover soundness of body and to preserve or restore its healthy operation must be left to those expert in this field. Actually mind and body are one; body is the structural basis and mind the functional activity when that activity takes the form we call mental. It follows also that part of the technique for promoting physical health is that of achieving a balanced and controlled mental organization.

Give at least as much care to the health of your mind as to the hygiene of your body, but do not become morbidly attentive to either. A working knowledge of normal physiology will enable you to do as well for your body as any amateur can hope for. An equal knowledge of the facts of scientific psychology will help you to detect the mental quack and the personality fakir. Shun them both.

Mental health and work. Mental health is essentially the maintenance of the integrity and unity of the self. The self is that organization of interests, impulses, memories and values that each must achieve for himself. We are not born with selves, but must laboriously construct them.

In infancy it is the discovery of material things and their resistance to our mere wishes that first promotes coördination and organized effort. The infant is never quite so much a unit, a self, as when intent on reaching some object or clambering over some physical obstacle.

In later childhood it is the adoption of goals and tasks that gives to behavior the rather patchy coherence that it does then exhibit. The flightiness and desultoriness of self-organization in childhood is due to the transient and fleeting character of these goals, and their frequent failure to serve any genuine function in the sheltered and tended life of children.

In adolescence the struggle to find the self and its place in the world is closely linked to the goals of mating and career. "What shall I do?" and "Whose shall I be?" are the dominant questions. Development of an organized self occurs around the thread of the career motive, the life plan.

In adult life, so closely is the self dependent on the organizing demands of vocation that the self and the job are identified. The answer to the question "What are you?" is most likely to be the indication of one's job—"I am a grocer," a doctor, a lawyer, a mechanic. The self and the task are one.

In mental breakdown one of the most useful aids to recovery is occupational therapy—reorganization of the self along the lines of a project, a task, a goal. In old age the collapse of personality is likely to be deferred until retirement, idleness, and loss of the task and goal occur.

The outcome is the suggestion that every healthy life is organized about a plan of action, a goal idea, which contributes just that unity of action and organization that we call the self. Whether this be an industrial, economic vocation, a philanthropic calling, or an artistic project, seems to matter little.

The main thing seems to be that mental health requires a thread of organization, and that nothing serves this purpose quite so well in young or old, boy or girl, man or woman, as a life plan or task. It is the unity of the life plan that constitutes and supports the integrity of the self. Helping the pupil to achieve such a life plan is one of the best contributions the school can make in education for mental health.

PROBLEMS

1. Find a chapter or book on "Mental Hygiene," not related to some very limited age, and make a brief list of such positive and constructive suggestions as you find given.

2. Where could you go in your neighborhood for a detailed psychological examination of yourself, your abilities and characteristics?

3. What psychological clinics or guidance bureaus are available in your community, and what functions do they serve?

4. Read some article or book on "self-rating" and report it to the class for discussion.
5. Describe some action of your own in which reality was not frankly faced. What was the method and the outcome?
6. Describe some of your own "mental limps" and analyze them in the terms used in the text.
7. Catch yourself at the time of some strong emotion and describe in detail your experience and behavior at the time. Did it really represent a failure of ready adjustment?
8. Cite specific instances from human relations to show that mental health requires inhibition and repression.
9. Examine your denominator carefully and decide for yourself whether it is properly suited to your numerator, so as to make a unitary value. How can you tell? Can denominators be too small for mental health?
10. Cite behavior which you think might appropriately be called "emotional immaturity." What in general are the signs of emotional immaturity?

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PART IV

GENERAL EDUCATIONAL PROBLEMS

CHAPTER XVIII

TRANSFER OF TRAINING AND FORMAL DISCIPLINE

A brief historical introduction. The student of education who reviews the long controversy over the transfer of training comes from it with a renewed sense of the human comedy. It is a long and pitiful story of the blind leading the blind, but a tale easily duplicated in any other field of human thought. Medicine, government, science, theology, all have chapters which the kindness of time will gradually wipe away. The corresponding chapter in the theory of education is that dealing with transfer and formal discipline.

It is necessary to remember how slowly human thought changes, and how few centuries we are removed from primitive animism. Then the acts of men were attributed to tiny personages inhabitating the human body, the demons and spirits, evil and good. After them it was an adventurous step to the Powers or Faculties—the Memory, Judgment, Will—as directing agents, and man himself a mechanism in their hands. Education was then the cultivation of these Powers, which were either strong or weak, regardless of the materials on which they were directed. Beyond the concept of these Powers it has been difficult to advance.

We owe some of this difficulty to Locke's conception of education. He was a vigorous critic of the supposed "faculties" and yet it was he who was largely responsible for the modern formulation of the notion of formal discipline. He would have children study mathematics, "not so much to make them mathematicians as to make them reasonable creatures . . . that having got the way of reasoning which that study necessarily brings the mind to, they might be able to transfer it to other parts of knowledge as they shall have occasion."

On this ground education stood until very recently—at least the education of the academic variety and beyond the elementary level. Curricula were planned, subject matter and activities prescribed, on the basis of the supposed "formal activities" they developed. Mathematics for reason; literature for imagination; languages for memory; manual training for endurance, and so on. The theory was that in addition to the remembrances one has, there is, over and above them, the memory, which makes these recollections possible. This memory, when strengthened, could remember better whatever it was turned upon, just as a saw, when properly filed, will cut any kind of wood better.

When skepticism began to be voiced, as by Herbert Spencer and many later critics, a valiant and quaint defense of the doctrine was attempted. Conventions were held on the subject and supporting resolutions voted. Public citizens were sent questionnaires and asked to testify if their studies of the favored school subjects had disciplined their minds, quickened their judgment, strengthened their memory and decision. Heated arguments were staged between the devotees of utilitarian science and the partisans of the well-entrenched disciplinary subjects of study.

The specific questions for educators were—Does what one gains in one field of study (such as history) carry over to other fields (such as carpentry) irrespective of the difference in subject matter? Are some subjects of study (as Latin) more valuable than others in that they more effectively prepare the pupil for *whatever* activities he may engage in? Is not this *formal* training more important for education than any of the particular information, the special skills or attitudes, and the items of *content* that naturally differ from subject to subject?

In due time the experimental method was applied, and a long series of studies appeared, for the most part inadequately planned and often erroneously interpreted. These fell into two groups. In the one a laboratory setting was used; the learning and testing dealt with artificial or very limited tasks—cancelling letters, tossing balls, memorizing lists, learning codes, estimating the size of objects, and so on. In the other set attempts were made to measure the effects, on ability in one school activity (such as reading), of studying another subject (such as grammar).

We shall not distress the reader with the recital of this long array of investigations. Nor shall we discuss in detail the numerous experimental errors that detract from the significance of most of them. References are given at the end of the chapter, in which those interested may find such surveys. Instead, we shall describe briefly one experiment in each of the two groups, the laboratory group and the school-situation group. We shall then consider the whole topic of transfer in the light of the account we have given of the nature of learning.

An illustrative experiment on transfer. An experiment reported by Poffenberger[1] will serve to illustrate some of the ingenuities adopted in studies of transfer and to afford suggestive results which, although without great statistical reliability, accord with the general outcome of such studies.

The pupils (adults) were divided into two groups, one group to receive special training, the other to serve as a control group. In the beginning, all were measured in certain operations. The experimental group was then given intensive training (100 lessons or practice periods) in a selected set of activities. At the end both groups were again measured in the same things measured in the beginning. This is a miniature school situation, with a selected curriculum, a set of "life activities" for which training is to prepare, and two groups of pupils, one to be "educated," the other not. The effect of education is to be determined by its influence on the activities not included in the curriculum.

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[1] A. T. Poffenberger, "The Influence of Improvement in One Simple Mental Process upon Other Related Processes," *Journal of Educational Psychology,* October, 1915.

The initial tests, used also as final tests at the end, were:

1. Naming forms as rapidly as possible (The substitution blank shown on p. 19 was used.)
2. Giving appropriate nouns in response to a list of adjectives
3. Checking, from special blanks, groups of numbers containing 3 and 5, or 4 and 7
4. Subtracting 17 from each of a list of two-place numbers
5. Multiplying each of the two-place numbers by 7
6. Dividing these products each by 7, to get the original list of two-place numbers

The "education" given the experimental group consisted of 100 practice trials with each of the following activities:

(*a*) Naming colors as rapidly as possible
(*b*) Naming opposites of each adjective on a standard list
(*c*) Cancelling 3 or 5 from pages printed with random numbers
(*d*) Adding 17 mentally to each of the two-place numbers

Improvement occurred in all these processes. In Color Naming the gain amounted to about 2 per cent; in Naming Opposites about 4 per cent; in Cancellation about 33 per cent and in Adding, 61 per cent. The question now is, to what extent, if at all, and in what ways, this "education" in the specific "curriculum" showed itself in the activities not practiced.

The experimental results. The following table gives the results for the two groups, when their performance at the end of the experiment was compared with that at the beginning. Only one of the groups was "trained," and none of the training was with these particular activities. Gain and loss are shown by + and — signs.

The Skill Measured	*Gain made by the Trained Group in percentage*	*Gain made by the Control Group in percentage*
(a) Things in which training produced unfitness	**Here the untrained group makes the greater gain.**	
Naming geometrical forms	**— 4**	**+ 8**
Giving nouns for adjectives . .	**— 3**	**+ 22**
Subtracting 17 from original list of 2-place numbers	**+ 10**	**+ 16**
Multiplying original 2-place numbers by 7	**+ 8**	**+ 22**

The Skill Measured	*Gain made by the Trained Group in percentage*	*Gain made by the Control Group in percentage*
(b) Things on which training had no appreciable effect	Here no reliable difference is found between the groups.	
Checking number groups containing both 4 and 7	+ 10	+ 12
Dividing new numbers by 7 .	+ 21	+ 19
(c) Things in which training in the "curriculum" produced greater fitness	Here only, the trained group makes the greater gain.	
Checking number groups containing both 3 and 5 . . .	+ 16	+ 8

If we compare these columns of gains and losses and ask in what way the trained group gained or suffered appreciably from their training, the following conclusions appear:

1. The "educated" group actually lost, in form naming, adjective-noun, subtraction and multiplication, as compared with the control group. Their special training had in some way made them *less fit* for these acts, although aside from this training both groups had equal opportunity to gain from having done the initial tests, having been generally active and "adapted" to the experiment.
2. In number-checking the groups containing 4 and 7, and in division, the special training had just no reliable effect. The differences in gain between the two groups are negligible.
3. The single thing in which the trained group shows greater superiority over their initial tests is number-checking groups that contain 3 and 5.

If we generalize these results, we should conclude that:

(*a*) Learning certain things has, on some other things, just no demonstrable effect.

(*b*) Learning certain things has, on some other things, a definitely interfering effect.

(*c*) Learning certain things, has, on some other things, a positively beneficial effect.

So far as transfer is concerned in these results, we may, therefore, conclude that transfer may or may not occur; when it does occur, its effect may be either beneficial or harmful, so far as the doing of other things is concerned.

It may be useful now to look briefly at the two sets of activities here used, the training activities and the test activities, to see what explanation may be suggested of such an outcome.

Interpretation of the results. Practice in color naming results in cue reduction in that process; color names tend to appear more readily than before in response to patches of color, the appearance of the test sheet, and similar cues. But in form naming, the color cues are absent, wholly new cues being presented, except for the appearance of the test sheet, and other "general" factors. To name colors in response to such general cues would only interfere with the naming of forms, and that is the effect found.

Practice in naming opposites facilitates the tendency to speak opposites in response to slight cues of the test sheet, the adjectives used, and other elements of the total situation. When the same test sheet and stimulus words are now used with the instruction, "Give a noun," the interference might be expected to be greater still. All the former cues are present, but the responses to which they have been trained are detrimental to speaking nouns. The figures bear out this expectation. In neither of these cases does the sheer practice in "the faculty of naming" appear to amount to anything.

Practice in cancelling 3 or 5 established definite checking responses to cues of these figures. In the test sheets, when 3 and 5 are the cues presented, facilitation in checking is found, even though the precise circumstances and mode of response are different. Because of these differences, the gain is only about half as great as that in the practice series. But in the checking of numbers containing 4 and 7, no training having actually been concerned with these cues, the two groups are quite alike. No "number checking faculty" seems to have been improved therefore; instead, specific responses were trained to specific cues.

Practice in adding 17 to a definite list of numbers produced great gain in that activity (61 per cent). Now in the subtraction and the multiplication tests, the very same lists of stimulus numbers were used. These familiar cues, tending to arouse *adding* responses, resulted simply in interference. The control group, without training in adding, fared better. In the case of dividing, however, *new* lists of numbers were used. The specific cues being changed, the trained responses were not elicited by other details to a sufficient degree to make any difference between the two groups of workers. No "power of calculation" seems to have been involved.

The influence of common elements. The transfer effect, its direction, amount, and even its occurrence, seem then to depend on two things:

(*a*) On whether or not the cues of training are present in the test situation with sufficient definiteness to provoke their previously trained responses

(*b*) On whether or not the responses thus provoked by the old cues occurring in the new situations are of any utility or any detriment in the new activity

This result has often been referred to as the "theory of identical elements." But there has been confusion as to what and where the identical elements are. A definition often used [2] is, "By identical elements are meant mental processes that have the same cell action in the brain as their physical correlate."

It seems more promising to say that the identical elements may be either similar cues provided by the situation, or similar responses among those appropriate to two situations. Since the provoking of responses depends upon the effectiveness of cues, the situation is reduced to similarity of cues in the situation faced.

If the responses trained to these cues in past learning, and now tending to occur in response to them, enter in any useful way into the response which the new situation requires, to that extent positive transfer will occur. What has been learned will assert itself. This is all there is to the problem of transfer. The only further questions are as to just what was really learned, during the training, and as to just how useful this is to be in the new situation. This will be clearer if we turn now to an illustration from the more concrete, though complicated field of school instruction.

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[2] E. L. Thorndike, *Educational Psychology* (Teachers College, 1914), Vol. II, p. 358.

The disciplinary values of high-school courses. As an illustration of the study of transfer problems in school situations, a series of studies reported by Thorndike[3] will serve. The investigation was first carried through on over 8,000 high-school pupils and later confirmed by repetition on a different group of similar pupils. The *training* consisted of the regular courses pursued by the pupils in high school. A carefully devised and elaborate set of "mental tests," given at the beginning and again (in a comparable form) at the end of a year, were used to show the effect of various courses on the pupils' ability to use their minds.

In these mental tests some pupils were found to have gained more than others, as the result of a lapse of a year and its activities. All the pupils were distributed in a chart according to the amount of their gains in mental ability, and it was then found how often each high-school subject had been "taken" by those making different amounts of gain. In this way a table could be derived showing the relation of each study to the tendency to show gain. Allowance had also to be made for a year of growth, and to practice in the tests themselves at the beginning of the year, but by complicated statistical procedures allowances for these variables and certain others were made. The preliminary table of results may be given in an adapted form, as follows:

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[3] E. L. Thorndike, "Mental Discipline in High School Studies," *Journal of Educational Psychology,* 1924, pp. 1-22, 83-98; C. R. Broyler, E. L. Thorndike, and E. Woodyard, "A Second Study of Mental Discipline in High School Studies," *Journal of Educational Psychology,* 1927, pp. 377*ff*.

The Relations of Studies to Gains Measured by the Relative Frequency of the Study in Groups Making Various Amounts of Gain *

Studies to Which the Larger Amounts of Gain Could Be Attributed		Studies to Which Practically No Gain Could Be Attributed		Studies to Which Actual Losses Might Be Attributed	
Subject	Points of Gain	Subject	Points of Gain	Subject	Points of Gain (Loss)
French	2.5	History	0.4	Civics	—1.2
Chemistry	2.4	Music	0.2	Biology	—1.4
Trigonometry	2.3	Shop work	0.1	Dramatics	—2.0
Physics	2.0	Spanish	0.0	Stenography	—2.1
General Science	1.9	English	0.0	Economics	—2.6
Latin	1.7	Drawing	0.0	Cooking	—2.9
Bookkeeping	1.3	Business	—0.4	Sewing	—3.5
Physical Education	1.1				
Arithmetic	0.7				
Geometry	0.7				
Algebra	0.6				

* Adapted from Thorndike, "Mental Discipline in High School Studies," *Journal of Educational Psychology*, 1924.

With this as a starting point, greater reliability was sought by combining into groups those subjects appearing to be of about equal disciplinary value. These groups of *subjects* might then be called *courses.* The disciplinary value of one such *course* was then determined by comparing students whose programs differed by only one such course. Thus, let us designate various courses as *A, B, C, D, E, F,* etc. Some students would have as a program, courses *A, B, C, D,* and other students would have instead programs made up of courses *A, B, C* and *E.* By comparing such students, of equal general ability, the relative value of courses *D* and *E,* in which their programs differed, was found.

In this way a comparative statement was arrived at of the various courses, showing, in terms of number of score points in the test, the amount apparently contributed to the pupils' gain by these respective courses. This was done for two different groups, in different years, and the relative results are shown in the following table, adapted from more extensive ones given by the investigators.

Relative Amounts of Transfer Showing the Difference in Points Gained by a Pupil Taking Any One Course As Compared with One of Equal Ability Taking Instead Course G, Which Appeared to Be "Neutral" So Far As Transfer Is Concerned *

Different Courses, Made up of Subjects with Approximately Equal Transfer Value	Relative Disciplinary Values in Terms of Points on the Test		
	1922-23	1925-26	Average
A—Geometry, algebra, trigonometry	+ 2.30	+ 3.64	+ 2.99
B—Civics, economics, psychology, sociology	+ .27	+ 5.50	+ 2.89
C—Chemistry, physics, general science	+ 2.64	+ 2.77	+ 2.71
D—Arithmetic, bookkeeping	+ 2.92	+ 2.28	+ 2.60
E—Physical training	+ .66	+ 1.00	+ .83
F—Latin and French	+ 1.64	− .70	+ .47
G—History, music, shop, Spanish, English, drawing, business	.00	.00	.00
H—Stenography, cooking, sewing	− .47	+ .19	− .14
I—Agriculture, biology	− .90	+ .60	− .15
J—Dramatic art	− .29	− .67	− .48

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* Adapted from a more elaborate table, from Broyler, Thorndike and Woodyard, *op. cit.*

On the whole, courses *A* to *D* appear to possess slightly more of the discipline of transfer value than the courses below them on the list, in which the transfer value is either very slight or even negative. The amounts of transfer at most are slight and the differences trivial. In order to understand the differences, a consideration of the nature of the initial and final tests of mental ability will be useful.

These tests were a miscellaneous set of "problems" in which "words, numbers and space forms are favored"; "the composite favors linguistic and mathematical abilities"; "this restriction to abilities somewhat closely allied to those specifically trained in studying languages and mathematics," is recognized by the authors.

Any differences in transfer gain are easily explained as meaning only that there was greater likelihood of cues being met in the tests which had been met in certain subjects, or of certain responses which had there been developed being useful in connection with the tests. That is, similar cues and useful reactions would be the basis of whatever transfer did occur.

The significant thing is, however, that there is so little evidence of any profit, of this general sort, derived from the year of work, and the approximate equality of all the courses and subjects. Thorndike concludes that "the facts of this experiment, if corroborated by similar experiments, prove that the amount of general improvement due to studies is small; that the differences between studies in respect to it are small, so that the value of studies may be decided largely by consideration of the special training which they give. . . ."

Still more striking is the fact that differences between the pupils quite overshadowed differences in the value of the courses. The brighter pupils, as shown by the initial tests, gained fourteen times as much as the duller ones, regardless of the course pursued. Differences between the special activities of the curriculum were far less important than differences between the pupils, and the consequent effects of their more considerable learning, not only in school but in life in general. Perhaps also the brighter pupils were more likely to have been occupied outside of school with such materials as those presented in the tests.

Calling attention to this fact, Thorndike writes as follows:

> The expectation of any large difference in general improvement of the mind from one study rather than another seems doomed to disappointment. The chief reason why good thinkers seem superficially to have been made such by having taken certain school studies is that good thinkers have taken such studies, becoming better by the inherent tendency of the good to gain more than the poor from any study.

When the good thinkers studied Latin and Greek, these studies seemed to make good thinkers. Now that the good thinkers study physics and trigonometry, these seem to make good thinkers. If the abler pupils should all study physical education and dramatic art, these subjects would seem to make good thinkers.

What determines the amount of transfer? Learning, as we have described it, is identical with transfer. Since learning is cue reduction, this means that acts developed for complex whole situations may thereafter be aroused by small elements of such a situation, encountered in a new context. And this is all that is found to occur in transfer. Cue reduction makes transfer possible; but what determines when and whether it will occur; how complete it will be, and how useful?

Assume that the conditions have been fulfilled which make transfer possible, that is, that a response, *XYZ*, has been often produced by situation *ABCD*. Now a *new* situation is confronted, which we may call *JKLD*. The response *XYZ* will be made only if the cue reduction has reached a point where *D*, a single element of the original situation (*ABCD*) is capable of *provoking* it, and if the other elements (*JKL*) do not effectively *restrain* it. There are, therefore, two parts to the problem—the tendency to *arousal by one element*, and the presence of *control by the context*.

Consider first the tendency to arousal. In the dull pupil, or if learning in any case has not proceeded far, then the single element, *D*, may not be effective as a cue. Only a *greater similarity*, such as that in situation *JBCD* will arouse the original response. Here there are three details, cues or elements in common, hence greater likelihood, for a given pupil or a given degree of learning, of *XYZ* being provoked.

We may generalize these facts in the following way:

1. With a given pupil and a given degree of learning, transfer will be more likely the more similar the new situation is to the old—the more common stimulus elements or cues there are in the two situations.
2. With a given pupil the transfer will be more likely the further the learning, or cue reduction, has gone. For the further the learn-

ing has gone, the smaller the necessary cue and hence the greater the likelihood of a common element being present.

3. With a given period of training and two given situations, transfer will be more likely and will occur sooner, the greater the brightness or learning ability of the pupil.

Up to this point the likelihood of transfer from one situation to another has been described only as a function of the degree of learning. But we must at once observe that if single cues in the new situation should operate alone, the response might be quite inappropriate to the new situation as a whole. It may well be that a response appropriate enough to situation *ABCD* might be unfortunate if made in situation *JKLD*. These two situations are more different than they are alike. Whether the old response *should* follow the *D* element or cue, depends now on what the *other features* of this situation happen to be.

Learning capacity (docility, brightness) alone makes transfer possible and likely but does not guarantee its usefulness. Only *docility combined with scope* can make education effective. In many cases the tendency of *D* to produce *XYZ* must be controlled by other cues in the situation. Action is effective only when *joint action* of all the available cues in the present situation occurs.

Importance of control in transfer. Transfer based merely on cue reduction or learning, and not controlled by sagacity, is as likely to be negative, that is, detrimental, as it is to be positive (beneficial). Positive or useful transfer will occur on only two conditions:

(*a*) When by *sheer chance* it happens that the response to the common element happens to be useful in the new situation

(*b*) When adequate scope, sagacity or com-prehension of many cues in the new situation permits the transfer to occur

We have already seen (in Chapter III) how uncontrolled transfer produces illusions of perception, absent-minded acts, bungling and neurotic behavior. It is easy enough to illustrate lack of control and its effects in the ordinary processes of school learning, in which some learned act, applied now to a new situation, turns out to be foolish because of ignorance or lack of observation of *other elements* in the new situation. In some cases the greater the brightness of the pupil, and the readier the transfer or generalization, the more likely are errors of a certain kind likely to occur.

Good examples may be found in the learning of spelling. The bright child, who has not yet learned to spell the word "conductor," is likely to misspell it when asked to write the word. He is likely to respond to *phonetic* cues in terms of his past experience with such sounds and write "conduckter," or "conducter." The dull child, instead, is more likely to misspell the word as "condimsler," or in some other non-phonetic fashion.[4]

The bright child, who has not yet learned to spell the word "jolly," takes a chance, reacts to phonetic cues, and writes it "goly" or "gollie," thus committing an "error." The dull child, not having learned to spell the word, does not write it, but finds some other word to use, such as "good," which he can spell; hence he makes no error. Error, in other words, may be produced by transfer, or generalization, if that transfer is not "controlled" by other cues in the new situation.

The bright child may misspell "rabbit" as "rabit." This is phonetically correct and previous experience with the phonetic elements is the basis of the correctness. But if such a child has also *seen* the word, as in reading, the *visual shape* of the word, with its two high letters in the middle, sloping off at each end, may offer an additional cue. If this is available from memory, it may conspire with the phonetic cue to produce two b's and positive instead of negative transfer occurs.

The teacher's responsibility for transfer. Since transfer is only an indication that something has been already learned, the teaching may have much to do with the general value of learning, that is, its value in situations other than that of the classroom and recitation. If the study of Latin results in little improvement in knowledge of English words or in ability to spell English words, this means merely that these cues and acts were not featured in the study of Latin. Making sure that such elements are incorporated in the Latin work has been shown to produce three times the "transfer" to work in English.[5]

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[4] See H. A. Carroll, *Generalization of Bright and Dull Children,* Contributions to Education, No. 439 (Teachers College, Columbia University, 1930). This is an analysis of the spelling errors of bright and dull children.

"Knowing when to multiply" is not likely to transfer well outside the classroom, or even within it, if multiplication is tied up always with a certain arrangement of figures, a certain way of putting a question, or a certain section of the textbook. Multiplying must be trained in a variety of situations, to all of which it is appropriate, in such a way that a very slight feature of the problem will be enough to suggest it. For the pupil not to multiply unless all the features—the arrangement of the figures, the form of the question, etc., occur means simply that cue reduction has not proceeded to a point where it will be generally serviceable.

This is in fact the basis of the doctrine of "generalization" which has often been stated as opposed to the account of transfer as due to common elements. Actually no difference exists between the two accounts, except one of terminology. Generalization is a useful term. It means the process of reacting to varied situations on the basis of slight features which they possess in common. For one to apply his knowledge *generally* means only that it has been trained to such slight cues that situations in many respects different may be reacted to in terms of such similarities as they have.[6]

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[5] A. A. Hamblen, *A Statistical Study to Determine the Amount of Automatic Transfer from a Study of Latin to a Knowledge of English Derivatives, etc.* (University of Pennsylvania, 1924); also W. W. Coxe, *The Influence of Latin on the Spelling of English Words* (Ohio State University, 1923).

[6] For an account of transfer in terms of generalization see C. H. Judd, *Psychology of High-School Subjects* (Ginn & Co., 1915), Ch. xvii.

Ability thus to generalize should be a part of the process of learning. That is, not only should acts be trained to reduced cues, but these reduced cues should be encountered in a variety of contexts. Special learning in connection with the context elements must also occur. When this is accomplished, then the joint operation of cue and context will be favored, and that useful transfer will be made possible which learning and sagacity permit.

The boy who could not apply the term "vertical" when his father held up a pencil, but only when the teacher held up a ruler, had not learned to generalize. That is, he was unable to react with the proper adjective to the slight common feature to which the adjective really applies.

On the other hand, the neurotic soldier, who reacts by a fit of terror to every noise in his environment, is generalizing too broadly. His responses are not sufficiently controlled by the context in which the special cue now occurs.

The contrast between these two examples brings us to the final question in connection with the topic of transfer—namely, what may be transferred?

What cues can produce transfer? Since transfer consists simply in the use, in one situation, of what was learned elsewhere, anything that can be learned may be transferred. But it is useful to call attention to the varied character of the processes that may participate in learning. Since learning is shown by the arousal of acts by partial stimuli, or reduced cues, the cues of transfer may be any items to which the learner is sensitive. These include the sensory qualities of experience, the variety of sights, sounds, feels, smells, tastes, and all the sensory experiences, simple or complex, associated with the learner's own body.

They include also all the experiences of feeling and emotion; all the elements of pleasantness and unpleasantness, excitement and calm, strain and relaxation, ugliness and beauty, and whatever other affective qualities experience may offer and the world may provide.

Relational elements are equally effective; the shapes and arrangements; the locations and sequences; the times, rhythms and other temporal patterns; the relations of likeness and difference; of cause and effect; such features as duration and distance. The position of a word in a series, the location of a proposition on the page, and similar trivial items, may become the cues to response. Moreover, the pupil's memories of all these varieties of experience may serve equally well as cues to his thought, feeling and conduct.

Transfer of thought, feeling, and conduct. Thought, feeling and conduct are the traditional fields in which responses may be classified, and the distinctions have a real usefulness, however arbitrary they may often appear to be. The response or act evoked by a reduced cue, and therefore involved in learning, may lie in any one of these fields, or in any combination of them.

In ordinary school learning responses on the level of thought occur in the form of memories, in the form of rules of procedure, in the form of judgments, decisions, plans. The pupil who is "reminded" of a disagreeable teacher by the sight of his geography book has "transferred" to the geography lesson an item of learning that bears definitely on his performance in it. The pupil who "recalls a rule of spelling" or a "technique in arithmetic" is similarly able to use, on the level of thought, what he has formerly learned on that level.

On the plane of feeling and emotion the evidence of former experience is perhaps more strikingly illustrated than in any other field of human activity. Our likes and dislikes, our fears and aversions, our feelings of shame, of mirth, of friendliness, and even the grossly organic feelings, such as nausea and excitement, occur with amazing readiness in response to slight elements of similarity, trivial common elements, subtle reduced cues. An important part of the education of the pupil consists of this training of attitudes, feelings, emotions, to readily available cues found in tasks, in personal situations, in social arrangements, institutions.

On the plane of overt motor adjustment, the postural level of behavior, similar transfer easily shows itself. Just as much of our learning is in the development of motor skill, so much of the transfer, expected or unexpected, useful or detrimental, consists of the arousal of motor acts by details of a new situation. The old soldier who "came to attention" at the command of the joker; the man in the elevator who "got out" on the wrong floor; the familiar case of the man who, on leaving the bathroom in daylight, reaches up and turns the switch thereby putting on the electric light, to his own surprise—all these are simple cases of transfer, positive or negative, on the plane of motor adjustment.

Most of our acts are complex. They involve at one and the same time elements of motor adjustment, of feeling, and of thought. Any school situation likewise involves elements on all these levels. The teacher's attention may be chiefly directed toward the verbal mastery of a paragraph. But the pupil meanwhile is establishing habits of action, habits of feeling, and habits of reflection and judgment, to all the elements of the situation. Many of the collateral gains, the incidental or concomitant learnings, may indeed turn out to be the items of greatest value in the socialization and ultimate adjustment of the pupil. Responses of skill, responses of appreciation, and responses of understanding—all three may be involved, and in complex combinations and patterns in any situation of learning, and therefore in any situation of transfer.

What may the pupil transfer from a lesson? Since transfer depends on learning, and whatever has been learned may be transferred to situations resembling, in some or other detail, the learning situation, elements of thought, feeling and conduct must all be considered. What, for example, may a boy be expected to transfer from a geography lesson or a geographical "project"? A few brief indications may at least suggest the complexity of what goes on in such learning.

On the plane of "thought and understanding" such a boy may discover new spatial and economic relations; he becomes acquainted with previously unknown "map locations"; symbols, such as marks on maps, come to have meanings of a new sort; he becomes able to plan or judge in geographical terms, using as an aid only the bare outline maps, or his fleeting memories of such diagrams, or various verbal propositions, which serve as adequate cues for his decisions.

On the plane of feeling and emotion, he establishes, perhaps, a dislike for the situation as a whole, because of such things in it as discouragement by the better performance of younger pupils; sarcasm or crossness or ugliness of the teacher; an aching tooth for which the teacher can scarcely be responsible; or the dull way in which the lesson is conducted. He may be expected to transfer such feelings—perhaps thereafter to dislike all geographical topics, to detest books shaped and colored like the geography text, to have a strong aversion for all teachers, and a distaste for school work of any kind. Even the countries or peoples about which the lesson was shaped may thereafter have a negative feeling tone, and thus afford the beginnings of such a vague reaction as "racial prejudice." Or the opposite of all of these feelings may be cultivated instead.

On the postural plane, the plane of overt movement, he may learn to slouch in his seat; to have a furtive glance, refusing to look companions or older people straight in the eye; to frown or scowl whenever geography or school is mentioned; to bite his finger nails in any kind of distress.

The teacher who supposes that in a given lesson, say in arithmetic, all that the pupil learns is to "write down the units and carry the tens when adding" is overlooking an important part of what goes on. There is no occasion for such a teacher unduly to feel the burden of his responsibility, and to worry over the personal and social fate of the pupil likely to result from the trivial learnings of this one lesson. It is, however, important to remember the complexity of any act of learning, and to realize that whatever reactions are now made to a situation as a whole have something to do with the behavior of the learner in future situations having elements in common with it.

The "academic achievement" of the learner is a joint product of (*a*) his original ability and (*b*) the specific cue reductions accomplished in the cumulative series of "lessons." So also the final character and social rôle to be played by the pupil will be jointly determined by (*a*) his native characteristics plus (*b*) the cumulative transfers of thought, feeling and conduct from the situations comprising his "education."

Why transfer can never be complete. Education, through situations not identical with those in which the results of learning are ultimately to be used, works always against a handicap. Even when the experiments have shown considerable transfer of learning from one situation to another, the amount of transfer improvement is less than the improvement shown in practice.

Several attempts have been made, on the basis of the experimental results, to express in quantitative terms the general amount of transfer that may be hoped for, from one activity specially practiced, to another resembling it only in certain common elements. Starch[7] makes the following estimate, on the basis of numerous experimental results:

> As a general estimate, on the basis of experimental work done thus far, the amount of transference between the extremes of 100 per cent and 0 per cent of transfer lies nearer to the zero end and is probably in the neighborhood of 20 per cent to 30 per cent of transference to closely allied functions and from that point on down to 0 per cent of transference to more unlike functions.

The basis of this fact can be found in certain studies of transfer in functions of a very physiological kind. These are the experiments on "conditioning," as it has been called, in the case particularly of lower animals, such as the dog. A brief account, and a partial correction, of these results has so definite a bearing on the psychology of transfer that we give here a much abbreviated description. Detailed reports of such studies will be found in the publications of Pavlow and his students.

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[7] From D. Starch, *Educational Psychology* (1927), p. 242. By permission of The Macmillan Company, publishers.

These experiments were performed mainly on dogs, to whose salivary glands had been attached devices for collecting the saliva secreted at any given time. When attention is paid only to the saliva, and no record made of the rest of the animal's behavior, what is called a "conditioned reflex" secretion of saliva can be secured.

When food is brought before the animal, saliva is secreted and the reaction time, the amount of saliva, and its quality, can be measured. The sound of a whistle, in the beginning, does not increase the flow of saliva. But if the whistle is blown each time food is presented, in time the sound of the whistle, occurring without the food, will produce salivation. Since this occurs only under the conditions of training, it is called a "conditioned" flow of saliva.

It is clear enough that it is only the biased interest in saliva that leads to this being called a single reflex, and that has also led to a false account of such "conditioning" as the fundamental fact in learning. Let us correct this impression before proceeding with the results of the experiment. If the dog's ears had been observed, as well as his saliva, it would have been seen that these also take part in the process. What really happens is that, in response to food and whistle, the dog makes a total reaction to that total situation. He secretes saliva, pricks up his ears, and does various other things. To include the ear movements alone is enough to show the error of the concept of conditioning.

Thereafter, in response to *either food or whistle,* the dog makes the same kind of *total reaction* that he previously made to the total situation. That is, among other things, he pricks up his ears and secretes saliva. Either the food or the whistle will now, as a partial cue, tend to lead to such a total reaction. But this is not conditioning of reflexes. It is just what we have been describing throughout our account of learning as "cue reduction," and is only a special and highly artificial and partly described case of it. With this correction of the account, we may now turn back to the topic of transfer.

A very important fact about learning is that the response to a partial cue, although *the same in kind,* is not usually so *complete* as the response to the total situation. Even the saliva, as measured in the case of the dog, was not so great in amount, when the whistle was sounded alone, as it had been in the original situation when both whistle and food were presented. Nor was it so good in quality; nor did it appear so promptly nor continue for so long a time. That is to say, *the response to a partial stimulus tends also to be a partial or incomplete response.* It is not quite so effective, even under the best conditions, as the response made in the original learning situation.

But this is precisely the fact that transferred improvement is less than the original learning might have led one to hope for. Since transfer is due to some common element, some partial identity, the transfer will be incomplete, and will vary with the number of common elements or cues present.

However effective the original learning, if it be accomplished in situations foreign to those in which the pupil is expected subsequently to perform, something will be lost. So much is this true that pupils can "recite" better in the same room where they have studied; they will pass examinations better under the same circumstances and with the same teachers as those concerned with the learning. Even a trained actor or public speaker performs better in places in which his practice has taken place, if other things are equal.

Turn back to Poffenberger's experiment on transfer, described earlier in the chapter. His learners gained 16 per cent in cancelling 3 and 5. When later tested in checking groups containing 3 and 5, or groups containing 4 and 7, they showed a distinct gain with the 3, 5 groups, but none with the 4, 7 groups. This is transfer. But note that although they had, in training, gained 16 per cent in cancelling 3 and 5, the transfer gain was only half this (8 per cent). And this was the largest amount of positive transfer shown in the experiment.

Implications for education. The implication of these facts for education, in the devising of curricula, in the planning of teaching, and in the conduct of the lesson seems obvious. So far as possible, things should be learned in the way they are to be used. The more the materials, the personnel and the circumstances of training approximate the conditions of future life, the more effective will learning there accomplished be in the subsequent life of the pupil.

If it be desired that, as the goal of teaching, pupils be accomplished in checking numbers containing 3 and 5 or 4 and 7, the very best training for that specific act is doing just that thing. To train in cancelling when life is going to call for *checking*, to train with 3 and 5 when life is going to present 4 and 7, is a process to be described only by the use of bitter adjectives.

To spend hours reading a dead language in the hope, only, that some of what is learned may transfer to the understanding of one's own mother tongue, is a waste of human energy, than which nothing is more sacred.

To prescribe laboratory science as a general remedy for slovenly "observation," or literature for "quickened appreciation," or mathematics for "reasonableness," is to forget the nature of learning.

For learning is not the cultivation of traits, powers, or faculties. It is the establishment of specific cues as the activators of particular behavior. Aside from such constitutional differences as pupils show, "traits" appear to be only the names of particular accumulations or groupings of such specific results. They are "generalized" only to the extent that the effective cues become reduced to such subtle elements as may be common to a great variety of situations.

It is just the desire to avoid wasteful occupation with artifact and to get closer to the concrete occasions of living that has inspired most of the project methods, purposive problem procedures, schemes of activity education, and the like. It is facts such as these that have always given a strong claim to merit on the part of the methods of apprenticeship and study-and-work combinations.

The sane educator should avoid extremes of either kind. It still remains true that many parts of a total activity can be improved by taking them as isolated segments and rehearsing them out of their context. It still remains true that man, above all other creatures, is capable of profiting from vicarious experience. The only care that need be taken is to see that the vicarious experience is really relevant, and that the item drilled is an actual segment of some important act.

There is the further possibility that many of the "intangibles" and not easily measurable outcomes of education, such as work habits, character traits, attitudes of diligence, self-help, coöperation, and the like are so closely tied up with our feelings and emotions that they may be trained to very minor or general aspects which almost any array of human activities may have in common.

In this respect there is much that could be said in favor of the "old-fashioned" procedures which sought to cultivate, if even by artifact, such socially valuable responses as adopting a task set by others, finishing a project once started, conforming to established regulations and expectations, meeting demands originating outside the self, adopting goals and adjusting one's own pleasures to their attainment, and subordinating the ego to the larger life and plans of society.

PROBLEMS

1. Find in some of the older books on educational psychology quotations showing faith in the possibilities of formal discipline.

2. Read in the literature the description of another experiment on transfer and report to the class the method and results.

3. Provide a column of two-place numbers. Add the two digits of each number, taking the time required. Prepare similar columns, and in each case (ten different columns) multiply the two digits

and take the time for each. Then in a final column, again add the digits and take the time. Did you improve in multiplying? Did this improvement transfer to adding? How can you tell? What cautions and control data are needed?

4. Read in Starch, *Educational Psychology,* the chapter summarizing many different experiments on transfer, and discuss with the class the difficulties and sources of error in such experiments.

5. Criticize the statement, "By identical elements we mean mental processes that have the same cell action in the brain as their physical correlate."

6. What bearing does the fact that Latin students usually do better work in English than students who have not studied Latin have on the doctrine of transfer or formal discipline?

7. If all high-school studies produce about the same slight amount of general transfer to general intellectual ability, what difference does it make what a pupil studies or whether he studies anything?

8. Show two ways in which science might be taught, one with high and the other with low transfer value.

9. Arithmetic teaching has often been criticized for introducing highly artificial and improbable problems. What difference does it make, so far as mastery of number relations and operations is concerned? What is the basis of the objection?

10. Look up the subject of "cross education" in a book on general psychology or elsewhere. What is meant by this and what relation does it have to the topic of transfer?

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CHAPTER XIX

PSYCHOLOGY AND THE CURRICULUM

Questions about the curriculum. The curriculum is the "subject matter" of education, the particular acts the pupil masters, the information he sets out to acquire, the tasks and problems placed before him, the experiences that are provided, with which he becomes familiar and in which learning takes place. Why is any given curriculum just what it is? Does psychology play any part in the planning of a curriculum?

"Incidental activities" also constitute a curriculum, not closely tied to the supervised program of the school. In the largest sense, life itself is a curriculum. Consider for example, the games the reader has learned to play, and why he learned them. He learned to play "pat-a-cake" and "peek-a-boo" because older persons imposed these upon him; croquet and marbles because other children were doing it; they were the fashion. He played with "imaginary companions" because he just happened upon it and found it to be fun. Dancing was learned, partly for social or "cultural reasons," partly because the doctor said it would "strengthen the arches." Many games were learned only because manufacturers and dealers found it profitable to make, advertise and sell them. Cross-word puzzles were undertaken because during a spell of illness there was "nothing better to do"; golf, in the hope that in old age it would provide an agreeable avocation, or even a professional career. And so on, through the long list of games, and the longer list of reasons and influences.

The games one learns are part of the curriculum of his education. They are not closely related to the work of the school, but they involve learning, teaching, motivation, methods of instruction, and all the other principles of education. They comprise part of the "incidental activities" which are an important part of the education of the whole person. One gets only a sense of confusion when he tries to state the basis on which the curriculum of games was chosen and organized. The history and philosophy of the school curriculum presents almost as great a confusion.

It is not enough to say merely that certain things are found in the textbooks. Anything could be put in such a book. Why are some things there, and not others? And why do the particular exercises or topics come in just the order they do, rather than in other conceivable orders? No one answer will suffice. Curriculum making has followed many rules and many ideals. It is our purpose in this chapter to show what some of the methods are by which the content and the sequence of educational subject matter have been determined, and to raise the question as to how they should or might be determined in the future.

In the first place, it is clear that what the curriculum is depends on what the *aim* or *objective* of education is considered to be. Then there is the further question of just how the curriculum is to be selected with this objective in mind.

An example from Plato. We shall begin a long way back in history. The Greek philosopher, living about twenty-three centuries ago, announced in his *New Republic* that education was chiefly to prepare youth to be the *guardians of the state*, that is, soldiers. He continues in the following words:

> Then in our judgment the man whose natural gifts promise to make him the perfect guardian of the state will be philosophical, high-spirited, swift-footed and strong.
>
> But in what way shall we rear and educate them? What is the education to be?
>
> Perhaps we could hardly find a better than that which the experience of the past has already discovered, which consists, I believe, in gymnastics for the body and music for the mind.

The objective is dogmatically announced. The curriculum is to be determined by "the past experience of mankind." But just what this experience has been, how reliably it has been formulated, and how eternal its judgments are to be, we are not told. Plato himself is not absolutely sure what the "experience of the past has discovered"; he merely holds a "belief" with respect to it.

Now, even if we assume the objective, is it true that gymnastics and music will make men philosophical, high-spirited, swift-footed and strong? And if so, just *which* gymnastics, and *what* songs or symphonies do it best?

Nevertheless, the case of Plato illustrates a typical method of curriculum construction, and one that is not yet wholly abandoned. One selects an objective on the basis of authority and prescribes a curriculum on the basis of faith, supported by some vague conviction about "the experience of the past." The faults of such a procedure are obvious. Aside from the wholly subjective nature of the data used, and the assumptions about the effect of this or that experience, no attempt is made to relate the experience to the actual needs, distresses or problems of the learner. But we have seen that it is some close relation of the act learned to the motivation of the learner that makes learning possible.

An example from Comenius. Some two thousand years after Plato, a Moravian educator, Comenius, mapped out a plan of teaching. To single out the particular detail we shall use is unjust to the historical importance of this man's work,[1] but with this apology we may use it as an illustration of our own problem.

Comenius asserted that "the ultimate end of man is eternal happiness with God." Education was to assist toward this end, by developing the traits of "knowledge, virtue and piety." He then chose, as the curriculum for this objective:

Reading
Writing
Composition
Ciphering
Physics
History
Geography
Catechisms

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[1] See P. Monroe, *History of Education* (Macmillan Co., 1907), for an appreciative account of the work of Comenius.

Measuring
Singing
Astronomy
Memorizing Bible texts
Learning moral rules
Mastering certain handicrafts

This may be an excellent school curriculum. But how are we to know? On what grounds can it be related to the professed objective or to the needs of the learner or the requirements of society? Do ciphering, singing, astronomy, really promote piety? Is there substantial evidence that even learning catechisms, Bible texts and moral rules does this? And if so, just what songs, just what problems in arithmetic, do it best? It seems clear that Comenius had only a personal basis for the selection of his curriculum and was far from demonstrating its adequacy, even assuming the objective to be sound.

A more modern illustration. Two hundred and fifty years after Comenius, an English philosopher, Herbert Spencer,[2] wrote a famous essay on education. In it he objected to the prevailing English view which had been vigorously formulated by John Locke[3] in about the same era as that of Comenius. This was based on the doctrine of *discipline.* The curriculum was to be chosen not because of the intrinsic usefulness of its content, but because of its effect on the general powers and attitudes of the pupil. Mathematics was the favorite instrument—"Not so much to make them mathematicians as to make them reasonable creatures . . . that having got the way of reasoning, which that study necessarily brings the mind to, they might be able to transfer it to other parts of knowledge as they shall have occasion" (Locke).

Spencer *maintained,* on the other hand, that the immediate or intrinsic usefulness of the material ought to determine what was learned, and that discipline could come, if wanted, from learning things "of most worth" as well as from learning things intrinsically useless.

The *usefulness* of knowledge was the degree to which it enabled the learner "to live more completely," and the various forms of such usefulness were surveyed in a logical analysis. On the basis of a similar logical analysis the prevailing subject matter of education in the schools was rejected, and the conclusion was reached that "the study of *science*, in its most comprehensive meaning, is the best preparation for all these orders of activity."

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[2] H. Spencer, *Essay on Education* (1860).

[3] J. Locke, *Thoughts on Education* (1693).

> Science . . . the household drudge [who] . . . has been kept in the background that her haughty sisters might flaunt their fripperies in the eyes of the world . . . will be proclaimed as highest alike in worth and beauty, and will reign supreme.

This argument of Spencer's was the definite forerunner of the modern science of education, with its attempts to prove all things, to measure results, to determine experimentally the values of materials and techniques, and to adapt procedure and curriculum to the objective and the pupil. But it was after all only an *argument*. It was not based on objective evidence nor on experimental results. It was based vaguely on "the experience of the present," as Plato's argument was based on "the experience of the past."

Some of the many methods by which contemporary students of education seek to avoid the errors of these earlier efforts will be suggested by the brief summaries given in the following sections. Some six or seven ways of trying to arrive at a curriculum will be illustrated by recent examples.[4]

The method of job analysis—spelling. Job analysis means a study of the *future needs* of the learner. What skills, information, or attitudes, will the pupil find a use for when he has become an *adult* and has abandoned his formal schooling for the practical activities of life? The answer to such a question may be used to guide the educator in mapping out instructive experiences and subject matter for the learner. Such a method may be applied in the kindergarten, in the program of general education, in the trade and professional school and in industrial education as well. Our example is chosen from the specific field of spelling.[5]

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[4] A valuable reference in this connection is W. W. Charters, *Curriculum Construction* (Macmillan Co., 1925). The *Twenty-sixth Yearbook* of the National Society for the Study of Education (1926), Vols. I and II, is wholly given to the topic "Curriculum Making, Past and Present."

It was decided that the words chosen as the basis of the spelling vocabulary in the lower elementary grades should be words actually used in writing ordinary letters. Therefore 2,000 such letters were secured and all the words tabulated. The letters were those actually written by adults—family letters, love letters, and letters to business firms, lawyers, physicians, newspapers, publishers, teachers, and various organizations.

From these letters (containing over 100,000 words) there were taken at random about 24,000 words (the first word of each line of all letters). These were of course not all different words; some words occurred many times, one even appearing over a thousand times; about one-third of them appeared but once. The use of 542 words, some of them often, made up seven-eighths of the total counted. These words were listed according to the number of times each was used. The most frequent (comprising one-fourth of the total) were *I, the, and, you, too, your, of, for* and *in.*

In further development of this method[6] the same investigator found the 1,000 words most commonly used, as shown in his own list and various other lists compiled by other students. These were divided into lists and were dictated for spelling by 70,000 children in the schools of many cities. The errors were recorded and in this way the relative difficulty or chance of correct spelling by different grades was found.

After this the various words were arranged in columns, each column containing words of equal difficulty. On the basis of the experimental results the standard ability of each school grade in spelling the words of each column was found. The words then constituted not only a spelling curriculum, presenting the words most likely to be used, but also a scale of performance with which the actual achievement and progress of any particular class or individual could be readily compared.

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[5] L. P. Ayres, "The Spelling Vocabularies of Personal and Business Letters," Russell Sage Foundation, Pamphlet No. E 126, 1913.

[6] L. P. Ayres, "Measuring Scale for Ability in Spelling," Russell Sage Foundation, Pamphlet No. E 139, 1915.

This method of curriculum construction has been applied in many other fields, in general education and in industrial training.[7] Its principle is experimental, and the results can be checked up by other observers. It seeks definitely to relate the things learned to the needs of the learners—not the immediate and felt needs, to be sure, but future needs, which it seeks to predict. Since in human beings of a certain level of intelligence the thought of future needs can become a present motive, the method conforms to that extent to our analysis of the learning process.

Many objections might be raised. Since the needs of individuals are going to be different, this method provides only for some hypothetical average person; many would learn to spell words they would never use; others fail to learn words later to be needed. But general education can be expected to provide only for general outcomes. And the pupil's education need not stop with his set spelling lesson.

New words are constantly coming into use which may be more needed in the future than those counted in current letters. Again, adults tend to use only words they have learned to spell, so that a count such as this does not necessarily show what words they should like to use, but only the words with which their own previous education has equipped them. It might even be suggested that words that adults are to use so often will be learned in the ordinary course of life, and that the class in spelling might better occupy itself with words to be used less frequently, since it would be these words which the adult might not have mastered in the incidental activities of life.

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[7] For an example in the case of arithmetic see G. M. Wilson, *A Survey of the Social and Business Uses of Arithmetic,* Contributions to Education (Teachers College, Columbia University, 1919).

But the psychology underlying this method is sound enough. Those acts are chosen which are to be called for on future occasions. These acts are now trained to cues which will be available on those future occasions, by reducing the stimulus which the pupil requires in his first attempts to spell the words.

The inventory of immediate needs. This method contrasts with that of job analysis, in that the *present needs* of the learner are used in selecting the curriculum, rather than the supposed needs of the future adult. To illustrate the contrast we may again choose the case of spelling for our illustration, although this method may be used as widely as any.

This time[8] the investigator raised the question—"What words, grade for grade, do children use in their own free written speech, and what words therefore do they need to know how to spell?" No *thought of* a future need is here relied on. The actual present distress or difficulty of the learner serves as the motive of the learning act. The method of arriving at the particular curriculum and its arrangement was as follows.

Over 1,000 children, in Grades 1 to 6, in four different parts of the country, were asked by their teachers to write themes. The themes were not on "lesson" topics, although they were written in the regular class hours. Each pupil wrote many themes, these being continued until tabulation showed that no new words were appearing in the pupil's writing. The number of themes ranged from 56 to 105 for each student.

In all these themes (over 75,000) the total number of words was about 15,000,000. But only about 4,500 *different* words were used by two or more per cent of the children in the grades in which the use of the word first appeared. Practically every one of these words was wrongly spelled by one or other pupil, the average number of misspellings per pupil being 48.

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[8] J. F. Jones, *Concrete Investigation of the Material of English Spelling* (University of South Dakota, 1915).

The *most frequently misspelled* words were made to constitute a special group known as the "100 spelling demons." This group begins with *which, their, there, separate* and *don't,* and ends with *to-night, hoarse, said, wrote* and *read.* The total list of often used words thus constitutes the *basis* of a spelling vocabulary for such children, and special emphasis may be given to the spelling demons.

This method of choosing and arranging the curriculum in terms of the immediate needs of the learner contrasts not only with the method of job analysis, but also with the notion of Comenius that spelling should be taught in order to promote piety and with that of Spencer that only science can administer to complete living.

Corrective training as a basis—physical education. In planning a physical education course for a high school[9] a method was introduced which has also been applied in various other fields. A list of common physical measurements was compiled, with standards of performance applicable to students of different ages. All the pupils were then examined, and grouped according to the degree and character of their physical *defects.*

The normal group, those free from defects, were allowed to engage in the usual athletic games, according to their interests. In a second group were placed those "organically and mechanically sound but with poor general musculature"; these were placed in a special gymnasium class designed to develop them in a general way and to arouse in them an enthusiasm for physical exercise and an interest in physical development. Those with marked defects were put into various sections of a third group, according to the nature of their defects. For each of these sections special "corrective" exercises were prescribed which were calculated to improve their special defects.

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[9] E. M. Todd, "Provisions in the High-School Curriculum for Correcting Physical Defects," *Journal of Educational Research,* Vol. III, No. 1.

In a similar way[10] a survey was made of the frequency of various errors in the written compositions of high-school and college students, and recommendations made concerning the time and emphasis given to the correction of such sources of error in the teaching of composition.

A method of "remedial instruction" in vogue in elementary schools adopting some form of the philosophy of spontaneous education and free activity also illustrates this method of corrective instruction. In general theory, the pupils in such schools are to occupy most of the time at school in "actual living" of some sort, pursuing activities according to their own individual and social interests, at least within the scope of the teachers' suggestions and the opportunities afforded by the resources of the school. It is hoped that in this incidental living they will achieve most of the information, the desirable attitudes and skills more formally impressed upon pupils living under the traditional curriculum of elementary instruction. From time to time they are examined, the content of the examinations being set by some preconceived notion of a curriculum in which pupils ought to be proficient. Those who do not do well in such tests are given special examination, with a view to "remedial diagnosis and instruction." Special teachers are introduced perhaps, to make good the defects from which the pupils are found to be suffering as the result of failure to achieve the expected learning in the course of free activity.

The report of the principal of a school in which the method of free education was being experimentally tried is instructive.[11]

> We were able to maintain this year three full-time remedial workers. . . . The remedial staff . . . has during the year worked with

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[10] R. I. Johnson, "The Persistency of Errors in English Composition," *School Review*, October, 1917.

[11] Report of the Principal of Horace Mann School for 1930.

101 children. . . . Gains from .7 of a year to 3 years' achievement have been secured. To my mind the remedial program is an example of what can be done with children.

In cases such as this the method of corrective education does not have any actual bearing on the problem of the curriculum. The curriculum exists pre-formed and is in the hands of the examiners and the remedial teachers as a set of standards of achievement. The theory would seem to be that only in the case of manifest failure to achieve the results unwittingly should the nature of the curriculum be consciously considered. When the method succeeds, it would appear to be due to the psychological fact that activities pursued by free choice are more whole-heartedly learned than when they are set before the pupil as school *tasks.*

A curriculum based on pupil interests—reading. It is useful to distinguish between the needs and the interests of the pupil at the time of his instruction. His needs may be very specifically known, as in needing to be able to spell a certain word in a composition. His interests may be more general, less specific. They indicate pleasure in the activity, and this, according to our analysis, also means relief from some irritant. But the precise nature of the difficulty may not be known; it may be relief from monotony that is felt; or relief from some previous annoying activity; relief from vague curiosity, and so on.

The interests of the learner have been used as a basis for curriculum construction and arrangement. The elective system in college instruction approximates this method. We may use as our example the case of planning the reading curriculum in the lower grades.[12] This particular case involved "the selection and grade classification of reading material according to the interests of children, as reported by teachers and pupils."

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[12] W. L. Uhl, *Scientific Determination of the Content of the Elementary School Course in Reading* (University of Wisconsin Studies in the Social Sciences and History, No. 4).

A questionnaire sent to over 2,000 teachers of reading in 80 cities, asked them to indicate:

(*a*) The reader (text) most used in the grade
(*b*) Two selections (from this reader) which pupils ask to re-read most, and the reasons given for their choice
(*c*) Two selections which the pupils discuss most enthusiastically, and the point of special interest in each
(*d*) The selection most effective in stimulating pupils to do independent thinking, and the reason
(*e*) The selection proving most satisfactory from every point of view, and the reasons

Similar selections were also requested in the case of dislike, lack of discussion, inability of the pupils to understand, and generally poor results.

A second questionnaire made numerous detailed inquiries concerning the interest of the pupils in lists of standard selections, contained in many readers. Such questionnaires were received from teachers in 49 cities, 741 teachers in all.

Then such selections, chosen because of their wide use and the variety of their appeal, were printed uniformly, and copies put in the hands of 529 pupils in a number of schools. In cooperation with the teachers, who understood the purpose of the inquiry, the pupils were asked to read the selections, to discuss them in class, and to write replies to a series of questions concerning their likes and dislikes for the various selections.

Selections	Frequency	Per Cent Favorable
"Little Red Hen"	33	100
"Cinderella"	14	100
"Santa Claus"	28	96
"The Bee"	18	67
"The Star"	11	46
"Old Woman and Pig"	11	27
"The White Lily"	17	12
"Rose, Daisy and Lilly"	15	0

The results may be illustrated by a few selections as reported by the teachers in the first questionnaire, in the case of first grade children.[13] These results are shown in the table on the preceding page.

On the basis of relative results showing the interest of the pupils in various reading selections, recommendations are formulated concerning the reading material to be included in the curriculum for each grade in the elementary school.

In a similar way teachers of psychology have often asked the students to vote, at the end of the course, on the relative interest of the various topics studied during the term. The suggesion is that later selections and arrangements of topics should be based, at least in part, on these expressions of interest. The method, in all its forms, puts a good deal of responsibility on the uninformed pupil and is perhaps least likely to go astray in cases where it is the activity rather than the content that is important.

Expert opinion and the curriculum—arithmetic. A favorite method of deciding issues in certain kinds of legal disputes is to call for the testimony of experts who are supposed to be qualified. Such an appeal to authority may often be the quickest way out, although it has its dangers. Certain features of a study of the economy of time in arithmetic[14] suggest this method, although not directly intended as a final formulation of a curriculum.

It was desired to find a list of problems in arithmetic "which arise in human activities and which possess a sufficient degree of utilitarian or socializing value to justify their being designated as minimal essentials." Although it was realized that "the ideal procedure would be to make a complete survey of activities to ascertain what arithmetical problems exist and the frequency of their occurrence," this plan was not judged to be feasible.

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[13] This list is adapted from a summary of the investigation given by Charters, *op. cit.*, p. 323.

[14] W. S. Monroe, in the *Sixteenth Yearbook* of the National Society for the Study of Education, Part I, "Second Report of the Committee on Minimum Essentials in Elementary-School Subjects" (Public School Publishing Co., 1917), pp. 111-127.

Instead, it was assumed that the problems possessing sufficient value to be included in the list "are to be found in our present arithmetic texts and in other accessible printed problem lists." Four *textbooks,* written by *previous* experts, were therefore chosen as the source of the materials to be examined. With this material as a starting point, the attempt was made to classify the problems, to relate them to official lists of occupations.

The authors were not found to agree closely. If a vote of three out of four of the experts be used as the basis for deciding upon the importance of problems or types of problems, "we arrive at the conclusion that there are not more than 372 type problems which are important enough to be included."

In a planned reorganization of the curriculum of a liberal arts college a committee on curriculum was appointed to undertake the project. By the method we have just illustrated, the committee proceeded to secure the catalogues and announcements of *other* colleges, in order to discover what other experts felt about the matter and in this way to arrive at an informed judgment as to what the curriculum of a college of liberal arts should be. Whatever the merits of this method may be, it has little relation to the problems of educational psychology.

Objective social survey as a basis—geography. One point of view in curriculum construction and organization emphasizes the "critical study of society" as a technique.[15] This would include—

(*a*) A study of the social needs of the individual learner
(*b*) The interests and abilities of the individual learner
(*c*) An experimental approach to determine the most effective organization of the educational materials

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[15] The example to be used here is Harold Rugg and John Hockett, *Objective Studies in Map Location,* Social Science Monographs, No. 1 (The Lincoln School, Teachers College, 1925).

The plan has been outlined in the case of the social sciences in the following way: [16]

> To illustrate from the social sciences, they would determine by a critical and thorough study of society what are the problems of contemporary life, what are the fundamental generalizations, what are the great concepts, what are the needed location facts and facts of time (*needed* in the sense that a person is uninformed without a knowledge of them). That is, they would secure rank-order lists showing the relative importance of these various materials. Having thus determined the materials, they would use them in experiments with pupils of varying ages and with the materials arranged in alternative modes of organization. And all of this would be done for the purpose of finding experimentally the most effective mode of organization.

The method may be illustrated by using as an example the study made by these authors of the relative importance of various facts and relations in the study of geography, with special reference to the location of countries, cities, mountains, rivers, oceans and the like.

Calling attention to the impossibility of an "encyclopedic" curriculum in geography, they begin with the following questions:

> Is Bucharest the capital of India? Is Warsaw in China? Should educated men and women be able to answer such questions as these? Is it of any importance that college students do not know where Havre, Zurich, or Barcelona are? Nineteen college students out of one hundred and twelve located Colombo in Colombia. Is that a matter of concern?
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> Out of an enormously long list of location facts that compose a complicated world order, which ones are of universal, frequent, and necessary utility to the great masses of our people? Specifically, what is the relative order of their importance?

An attempt was then made to secure such rank-order lists for twenty different varieties of geographical facts. While recognizing that an empirical study of what people do must be supplemented by the judgment of "frontier thinkers" as to what they should do, it was believed that the factual value of different materials such as these could be determined by a tabulation of their relative frequency and prestige in contemporary usage.

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[16] *Ibid.*, p. 21.

Using a great number of sources or "criteria" and weighting these in ways which need not be detailed here, they arrived at such a rank-order for the twenty types of location-facts by tabulating the occurrence of these items on the following bases:

1. Bank clearings (for cities of the U. S.)
2. Statistics of trade (for all countries)
3. Statistics of population (for cities and countries)
4. Area of territory (for countries)
5. Number of magazine articles published in 4 years (dealing with regions, cities, mountains, waters, islands)
6. Frequency of mention in critical journals
7. Frequency of mention in treatises on history and world affairs
8. Data from previous studies of newspaper and magazine allusions
9. Statistics of freight tonnage (for ports of U. S.)
10. Value of total commerce (for ports of the world)
11. Number of miles of railroad track (for railroads)
12. Total operating expense and revenue (for railroads)
13. Percentage of world output of important minerals (for regions)
14. Amount of traffic over ocean lanes of trade (for trade routes)
15. Percentage of population engaged in manufacturing (for regions)
16. Areas of dense population
17. Areas of production of agricultural goods (for regions)

So far as the mere knowledge of locations is concerned, and with no necessary conclusions as to historical or other sorts of importance, rank-order lists for the various items of the world's geography result, such as the following sample will illustrate:

40 cities of the U. S., beginning with New York, Chicago, Philadelphia, Boston, San Francisco, Detroit, and ending with Hartford, Houston and Harrisburg

61 countries of the world, beginning with United States, France,

Germany, China, Great Britain, Russia, Japan, and ending with Siberia, Salvador and Paraguay
30 rivers, beginning with Rhine, Nile, Danube, Mississippi, Hudson, Volga and ending with Elbe, Ohio, and Meuse
40 bodies of water, beginning with Pacific, Atlantic, Mediterranean and ending with Long Island Sound, Puget Sound and Indian Ocean
12 U. S. railroads, beginning with Pennsylvania, Southern Pacific, and ending with Great Northern and Missouri Pacific

This accomplished, the remaining problems are conceived to be:

(*a*) Discovering the relative importance of location-facts as compared with other material in the total social science program
(*b*) Determining how much of this material shall be attempted, on the basis of the time available and the relative importance of the facts
(*c*) Devising the most effective technique of learning such location-facts, in company with the other materials of the program

This method of planning a curriculum makes many contacts with psychology. It involves a psychological analysis of the nature and process of learning and teaching. It requires an experimental and objective attitude which the study of psychology should do much to foster. It uses techniques of measuring "values" which, while not exclusively psychological, are more nearly related to various psychological methods than to those of any other science. It leads to questions of technique and of method—of presentation and organization of materials which fall well enough within the province of the experimental psychology of education.

Planning a college curriculum. The illustrations cited have been concerned with small portions of a curriculum, rather than with large sections of an educational program. We may conclude with the account of a more elaborate undertaking,[17] resulting in a plan for the required courses in the curriculum of a college for women.

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[17] Charters, *op. cit.*, Ch. xxvii.

The assistance of women college graduates, who were homemakers or were unmarried and engaged in vocations, was enlisted in a job analysis of their activities in the years after graduation. Several hundred women kept diaries of the activities carried on for a period of one week, and these activities were then classified and analyzed into twenty-three groups, common both to the married and the unmarried. These activities were to be used as the basis for determining the content of the college course for such women. It was then necessary to determine which of these common activities might be provided for through school instruction. The groups of activities resulting were:

Foods
Clothing
Physical hygiene
Communication
Reading
Recreation and play
Social relations
Civic relations
Personal study
Schooling
Reproduction
Mental hygiene
Religion
Music
Art
Literature
Nature
Increasing the circle of interests
Free associative thinking
Introspection
Increasing the income
Vocational activities
Random interests

Decision as to which of these would yield to the methods of school instruction in a profitable way was made by the consensus of opinion of experts in education. The subjects thus chosen to constitute the "cultural core" of the curriculum of a college for women were as follows:

Clothing: About equally important for both married and unmarried women
Mental hygiene: Including individual and social adjustments of a psychological kind
Composition: Oral and written English. About 20 per cent of the activities involved communication
Social science: Covering civic, economic and political problems of a wide range

Reproduction: Including problems of marriage, and related to the subject of physical hygiene
Esthetics: Appreciation of art, drama, literature and nature, and certain ethical and philosophical topics
Financing: A practical course from the point of view of the consumer, including income, costs and budget matters

Many activities recorded in the job analyses are not provided in this core curriculum. Some of them related only to one of the groups (married or unmarried); some, being strictly vocational, were felt to lie outside the province of the liberal arts college; others seemed best taken care of in incidental ways; some were not believed suitable for formal methods of instruction. Since this represented only the required curriculum for all students, some interests could be taken care of by elective subjects, according to individual needs.

It was believed that such a "cultural core" curriculum would "assure to each woman a consideration of the quite fundamental activities with which all women within the national group are concerned." It will be observed that in this enterprise many of the methods we have been illustrating were used to supplement one another. *Job analysis* was undertaken; many of the future needs were identical with the *immediate needs* of the students; *expert opinion* was utilized in selecting the subjects suitable for college instruction; the diaries kept were in themselves the raw material of a *social survey;* provision was made for *individual interests* by the elective topics to be grouped about the "cultural core"; the general plan adhered closely to the original liberal arts *objective.*

Psychology only a contributing factor. In the planning of a major curriculum, psychology is only a contributing factor. It may supply questions, methods of investigation, and critical comment; but many other educational specialties must also contribute. There are philosophical and administrative problems; social, economic and industrial considerations, as well as ethical and financial ones.

Within the major curriculum psychology may be still more concerned with problems of organization, effective sequence, relation of activity to motive and adaptation to individual differences. The problems of the curriculum must always be closely related to those concerning the technique of instruction. Psychology also must be mainly responsible for the knowledge of the nature of learning, its possibilities, its effects, and for information concerning the character of the learner who is to *live* the curriculum which is his education.

PROBLEMS

1. Make a list of the games you have mastered, or the books you have read, and try to discover just why these, rather than others.
2. Examine this book on educational psychology and see if you can discover why the chapters follow their present order.
3. What fields are mapped out for your own educational program? On what grounds were just those subjects chosen?
4. Should students be allowed to decide their own curriculum? Under what circumstances?
5. Read Herbert Spencer's famous "Essay on Education" and discuss with the class the arguments there presented.
6. How would you discover by job analysis what might best be done in the sewing class? The woodworking class? The class in educational psychology?
7. How could the "inventory of immediate needs" be applied to organizing the course in algebra?
8. How would you undertake to base a physical education program on "pupil interests"?
9. What methods were probably used in formulating your course in educational psychology?
10. What objections might be made to the "contemporary survey" as a basis of curriculum construction?

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CHAPTER XX

THE BEHAVIOR OF SCHOOL CHILDREN

Problems of "deportment" have always played a large part in the work of the teacher and principal. The current tendency is to substitute the term "adjustment." The shift in emphasis is from the comfort of the teacher to the welfare of the pupil. Teachers are naturally concerned with pupil behavior that reflects on the authority and prestige of the teacher, or that interferes with the orderly and dignified conduct and management of the classroom. The "rod" was often used as a possible cure for dullness, but more often as a penalty for breaking "the rules."

Problems of pupil "management" will perhaps never be absent from education, certainly not from education under compulsory attendance laws. However zealously educators may aspire to teach pupils to manage themselves, they can scarcely escape the preliminary burden. Even educated adults require management by others in the interests of the group. Relations between teacher and pupil, or among pupils when they "govern themselves," are full of intimate psychological problems. Can a brief survey of pupil behavior and misbehavior offer anything of value for such complicated problems of human relationship?

However much we may emphasize conduct as a problem of adjustment; however much we may exalt the sanctity of the individual over institutional rules and the comfort of teachers, we cannot escape the fact that misconduct is a reality and must be handled. In highly developed school systems the visiting teacher, the student counselor, the clinical psychologist may assume responsibility for the more serious and intractable cases. This calls for a skilled technique and for detailed individual consideration of which no account can be briefly given.

We may, however, consider such general features as the studies of school behavior have brought to light. The study of general tendencies and group characteristics may afford a useful background from which the student of education may proceed to more detailed studies of misconduct, school discipline, class management, and personal adjustment. It may be well to begin with a brief sketch of the normal tendencies of behavior during the school years.

Normal trend in behavior. Before the average child becomes of school age (if we omit from our account the preschool agencies of the nursery and the kindergarten classes) he has accomplished a surprising amount of development and perhaps a good half of his learning.[1] The bodily structures and functions have developed. Motor coördinations have advanced from practically a zero point to a degree of command and precision that enables the child to leave the home and venture into the world of the school. Thought has evolved, in terms chiefly of gesture, imagery, and language, to a high level of adequacy. Emotional organization and gradation have established an effective base for future development and particularization. A period of negativism culminating at about the end of the second year will have been passed through. Individual patterns of attitude, such as those we have called introversion and extroversion (see Chapter V) will have already become fairly characteristic in degree or balance, either on the basis of heredity or on the basis of early experience, training, home situation.

A second stage of development which is commonly recognized will also have been fairly completed—the period often called the questioning age, terminating at about the time of school admission to the first grade. This period has been marked by a rich intellectual curiosity. The period of eternal questioning will have yielded a reasonable fund of information, and curiosity will have been either amply encouraged or more or less checked and discouraged.

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[1] For a detailed account of the course of human development throughout the life span see H. L. Hollingworth, *Mental Growth and Decline* (D. Appleton & Co., 1927).

The characteristic tendencies to fantasy and make-believe will have gradually given way to some more ~~or less clear~~ distinction between the world of "reality" and the subjective world of wishes and fancy. The average child of six years will be capable of distinguishing between truthful report and willful misrepresentation of facts. Much further analysis and appreciation of the nature of the "objective" world of adults will yet be required, however, and "imaginary companions" will not have been entirely abandoned by the bright.

The child's drawings will reflect much of the picture of mental development at this age. It is the age of "descriptive symbolism," in which drawings portray what is known to be there, rather than direct depiction of what is presented to the senses. Standards of behavior will still be highly specific. No appreciation of the nature of right and wrong will yet have been well developed, although many distinctions will have been learned between things that are and are not permitted or approved by the elders.

At the age of three, typical lines of childish occupation and interest do not cover a time span of more than a quarter of an hour, and variety, fickleness and activity are the rule. There will in the years immediately to follow be strong individualistic tendencies, struggles for self-expansion, plays will not easily take a socialized form, and a fairly strong sense of property and personal rights may be expected to show itself under ordinary conditions. Community of knowledge is extremely limited and what the school calls socialization is just on the point of explicit cultivation.

The elementary school years. The years of the early grades will cover mainly the span from the questioning age of preschool life to the period of puberty and adolescence—a long stretch sometimes called the "big Injun age." The designation tells a long story. The bodily signs of sex maturity are not yet in evidence, and interests tend to keep boys and girls apart rather than to draw them together. Rivalry rather than coöperation is strong. Boys will still be larger and stronger than girls and will excel them in the muscular dexterities.

Social pressures will have strongly differentiated the behavior and interests of the two groups, boys and girls. In both cases physical and intellectual development will now have reached a point where greater freedom is permitted; children released from the close supervision of the home emerge into the more impersonal supervision of teachers and administrators. This impersonal régime may often be one for which they have been ill-prepared by the fond attentions of parents, uncles and aunts, and considerable rubbing off of the sharp corners of individualism will be required.

The period has been described as one of "competitive socialization." Scorned by the adolescents of their acquaintance, who now seem like grown-ups, and in turn shunned by the younger children who seem now to be "babies," there is a strong tendency for like ages to flock together, and for the environment to be exploited by juvenile groups and "gangs." Play activities will now be very social in the sense that many individuals may take part. But there will be little subordination of individual prowess to the good of the group. Individual competition will be strong, but a keen need for the presence of an audience will be felt.

Boasting, bullying, teasing, showing off may be expected, and on the part of the boys considerable interest in exhibitions of fortitude, speed and strength, cleverness. Concern over features of form, finish and grace will be low; excitement, speed and adventure will be preferred. Livelier modes of intellectual play and games will also be appreciated. Collecting activities and interests will be keen and can easily be directed into useful channels.

From the point of view of school "discipline" the middle of the period, the 5th and 6th grades, will be the most taxing on the patience and serenity of the teacher. Sex curiosity, just developing, may lead to disapproved outlets, inquiries, mildly obscene talk and acts. The failure of high intellectual appreciation of the moral criteria of conduct will make behavior strongly influenced by individual loyalties. The general noisiness, roughness and "savageness" of much of the behavior of this period has led to that quaint notion among early educators that children of this age were "recapitulating the savage pigmy" period in the development of mankind. A large part of this impression is due to the physical vigor and restlessness of the period; to the equivocal status of being neither a baby nor a grown-up; and to the intellectual limitations which fail to grasp the conventional categories of social ethics except in the realm of individual and team interests.

Special influences at home do much to shape the behavior of children during this period. It is then that the effect of being an only child, a spoiled child, are most likely to bring the pupil into overt clash with the social expectation. Mild neurotic tendencies may begin to show themselves in recognizable form, and the "problem child" and the "delinquent" become objects of school concern.

Excessive egocentricity and selfishness may be expected. Actual or fancied inferiorities of endowment or of social status may lead to indirect modes of adjustment, rather than to a frank facing of reality, and this is a period in which understanding rather than mere control may count for much on the part of the educator. Infantilism of conduct, failure to grow up emotionally, may in this period be frequently encountered and may receive either the proper adjustment or instead be more permanently fixed as the pattern of the individual attitude.

Mild speech disorders, and other symptoms of "nervousness" are frequent during the elementary years, and often lead both to refractoriness of conduct and to misunderstanding on the part of teachers. There is likelihood that early tendencies to aggressiveness or to submission will in these years receive that sort of treatment which will either eliminate or fix them as permanent "traits" of the individual, whatever may have been their mode of origin.

This is also preëminently the period where useful steps by way of education, emotional and vocational guidance may be undertaken. It is for these years that the visiting teacher as an agency for the better adjustment of home and school life has developed.

Trends in the high-school age. The awkward age, the period of puberty and adolescence, has received much attention on the part of educators, and much superstition has grown up about the characteristics and phenomena of the high-school age. Adolescence is, to be sure, a dis-ease; but this is very different from a disease, and much of the discussion of the period gives the impression that adolescence is a clinical entity rather than a social phenomenon, based on psychological features of personality.

The awkwardness of the high-school age shows itself in the appearance and bearing of the pupil. This is due to the fact that following puberty there does appear a readjustment of physique. Sexual maturity is accompanied by changes in growth that make even the clothing of the adolescent ill suited. Sleeves quickly become too short; dresses too tight. Changes of voice, the appearance of hair, and the physiological changes associated with the period add to the impression.

The awkwardness is also markedly social, because of the equivocal status of children of this age. On the one hand parents and teachers expect adult standards of conduct. On the other hand, close supervision and dictation are still indulged in, belying the intimation of adulthood. Boys and girls now become more definitely interested in each other. Yet, because of the earlier maturity of girls, earlier associations tend to be broken down and friendships made, on the part of girls, with older boys; on the part of the boys, with younger girls.

The awkwardness is also economic. Interests and activities are aspired toward for which the dependent adolescent is wholly unprepared. He is still dependent upon his parents for clothing and food, yet wishes to be man or woman, and to undertake independent projects, expenditures and alliances. The more complicated the society the more do the capacities and interests of the adolescent conflict with the possibilities. The prolongation of infancy, which requires of the young ever longer and longer periods of training and dependence, conflicts with the biological development of individual impulses and interests, which run their own course.

Parents do not easily throw off their habits of treating children as infants. Often their own occupation and peace of mind appear to depend on clinging close to the young and perpetuating in them attitudes of infancy and dependence, just when the young themselves are trying to effect a mentally hygienic separation from family dependence.

The awkwardness is also intellectual. Doubts and anxieties arise in the more intelligent. Old rules of conduct, old maxims and dogmas appear to have little foundation. Even the cherished beliefs of childhood—about Santa Claus, the stork, the perfection of parents—are questioned. An outlook upon the world and an interpretation of life come to be needed. With the less intelligent the ready acceptance of some creed or doctrine serves the purpose. With the bright a distressing period of upset and intellectual stress may ensue. And these experiences will express themselves in devious ways in school conduct.

Emotional awkwardness arises in part because of the presence of impulses and interests, attachments and enthusiasms foreign to the complacent period of childhood. The effort to "put away childish things" is not easy. Emotion is in the main the expression of just such conflicts and breakdowns in adjustment as these situations of physical, social, and economic awkwardness suggest.

The period is preëminently one in which genuine irritants and modes of distress may be made the motives for educational activities. But this requires an intelligent appreciation of the precise nature of those distresses, an impersonal and objective analysis of them and attitude toward them. The general trend of adolescent interest is, however, strongly prospective—What am I to do? What shall I be? How can I best prepare for my career?

Such a brief survey of normal trends of behavior as we have here had space to give surely falls far short of the information concerning human growth and development needed by the teacher. But some notion of the normal expectations of behavior during successive school periods may have been suggested. We may then turn, with this background in mind, to somewhat more detailed studies of some of the more specific types of misbehavior with which the school may be concerned.

What do teachers call misbehavior? A questionnaire study of teachers' notions of undesirable behavior reported by Wickman [2] offers many instructive suggestions. He first studied the frequency with which different forms of school misconduct were reported by the teachers of elementary school children in various cities. The following table shows the relative incidence of these complaints, arranged in order of decreasing frequency, based on reports of nearly 900 pupils by a large number of teachers.

Having made such surveys of the range and variety of pupil misbehavior as reported by teachers, various ratings were secured from teachers showing their estimate of the relative importance of typical types of "misconduct." The complaints registered as misbehavior are so varied that Wickman suggests that "A child entirely free from all these behavior disturbances might very well be regarded with some alarm."

Naturally enough, the teachers rated as more serious those acts which resulted in school disturbance—the disturbance of the general class morale, of other pupils, and of the teacher. These were the active, aggressive acts, rather than those of shyness, withdrawing and passivity. These latter failings, however, may be more serious from the point of the mental health and future adjustment of the individual pupil.

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[2] E. Wickman, *Children's Behavior and Teachers' Attitudes* (Commonwealth Fund, 1928).

Total Incidence of Behavior Problems in 874 Children Reported by Teachers of an Elementary Public School*

Behavior	Percentage of all Pupils	Behavior	Percentage of all Pupils
Whispering	74.7	Physical coward	8.8
Inattentive	59.0	Nervous	8.7
Careless in work	44.4	Wilfully disobedient	8.2
Disorderly in class	38.8	Destroying property	8.2
Interrupting	38.7	Unhappy, depressed	8.0
Failure to study	36.2	Quarrelsome	7.9
Shy, withdrawing	35.2	Stubborn in group	7.5
Lack of interest	31.8	Rude, impudent	6.7
Overactive	30.9	Impertinent, defiant	5.6
Cheating	29.5	Carrying grudges	4.9
Oversensitive	25.5	Stealing articles	4.0
Neglectful	25.4	Masturbation	3.9
Physically lazy	20.8	Enuresis	3.9
Lying, untruthful	19.6	Sissy or tomboy	3.6
Unnecessary tardiness	17.6	Suspicious	2.1
Acting "smart"	14.6	Cruel, bullying	1.7
Overcritical	14.2	Profanity	1.7
Imaginative tales	13.3	Truancy	1.6
Meddlesome	12.6	Temper outbursts	1.5
Sullen, sulky	12.5	Stealing money	0.7
Domineering	12.1	Stealing food, sweets	0.7
Slovenly appearance	11.8	Obscene notes, talk	0.3
Suggestible	9.4	Smoking	0.2
Fearful	9.3		

* From Wickman, *op. cit.*, p. 80.

The criteria of misconduct. What constitutes misbehavior is clearly dependent on the criteria of behavior. The natural attitude of the teacher is to consider those acts misconduct which interfere with the work of learning and teaching as school activities. That the very favoring of the withdrawing, unadventurous and dependent behavior which may make school work proceed more easily may result in the emphasis and perpetuation of juvenile traits that will be a handicap in adult adjustment cannot be denied. It is just as obvious that some of the traits that make a youth a "school problem," and perhaps even a disagreeable member of juvenile groups, may in adult life appear as aggressive virtues and aid to adjustment and accomplishment.

The conflict between behavior suited to the individual welfare and that suited to the group enterprise is no new one, and it has always been present in school work. Formerly, the individual destiny was subordinated to the smoothness of the group project. In recent years more and more propaganda have been directed toward the development, on the part of the teacher, of an interest in mental hygiene and a concern for the intimate personality as well as the knowledge and skill developed by the pupil.

The freer organization of schools and classes in modern education has been attended by a relaxation in the notion of what "order" is, although the table of misbehaviors still shows "whispering" to stand at the top of the list. It seems clear at least that only a relaxed standard of schoolroom behavior will enable the already overburdened teacher to assume also those responsibilities for the management of personality and temperament which other social agencies are so glad to relinquish to the educator.

It is certainly not too much to require that part of the equipment of the teacher consist of a generally correct notion of the normal tendencies and behavior of children of various ages and degrees of development. To add to this some knowledge of the relation between conduct and other variables, and to possess some insight into the situations making for unhealthy mental development in the young is a great advantage. To expect the school also to provide all the resources of the clinical psychologist probably means further specialization and division of labor, rather than the development of this additional skill on the part of every teacher.[3]

In the following sections certain fairly well substantiated relationships will be described, on the basis of group observations. Every instance of school misconduct is, of course, in some respects peculiar to itself. It involves a particular pupil, with his own unique background, life situation, level of understanding, and motivation. It involves also a particular teacher with his or her estimate of the act. It often involves also special complications with other pupils, with home influences and other factors. The general relationships can then but indicate broad lines, the nature of which can usefully be borne in mind in the evaluation of particular instances.

School conduct as related to age and sex. Wickman, whose study of teachers' attitudes and pupils' behavior we have already considered, found that boys were about twice as likely to be reported for misbehavior as were girls. And for practically every one of the classifications of misconduct, more boys were reported than girls. Certain types of conduct are socially "tolerated" in boys, and early trained out of girls by social pressure. Aside from these pressures, which are applied from almost the day of birth, no clear evidence exists that the two groups would behave differently.

By the age of school attendance, at any rate, boys are more disposed to just those noisier, more muscular, and more aggressive activities which teachers are so likely to rate as misbehavior. Teachers thus favor, in boys, activity more closely resembling that socially encouraged in girls. A study of the incidence of school misbehavior, as reported by teachers, made by Haggerty,[4] shows the variation with sex and also with age, according to the following graph. The scores are a combination of frequency and estimated "gravity" of the offense.

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[3] For some of the solutions of this practical problem see: M. B. Sayles, *The Problem Child in School* (Joint Committee on Methods of Preventing Delinquency, 1925); E. A. Irwin and L. A. Marks, *Fitting the School to the Child* (Macmillan Co., 1924); J. J. B. Morgan, *The Psychology of the Unadjusted School Child* (Macmillan Co., 1927).

[4] Melvin Haggerty, "The Incidence of Undesirable Behavior in Public-School Children," *Journal of Educational Research,* September, 1925.

Again, the undesirability of behavior on the part of the girls is only about half as great as that of the boys. For girls the curve rises on the whole, with the maximum of undesirable behavior at the age of puberty, after which there is "improvement." With the boys there are two peaks of undesirable behavior, one in the second year of school (seven years) and the other at eleven years, at about the 6th grade. This is the period dramatically described in the literature of child psychology as "the big Injun age." The lower incidence of undesirable behavior in the high-school years (fourteen and beyond) is undoubtedly in part determined by the elimination, before that age, of many of the more obstreperous pupils, both boys and girls.

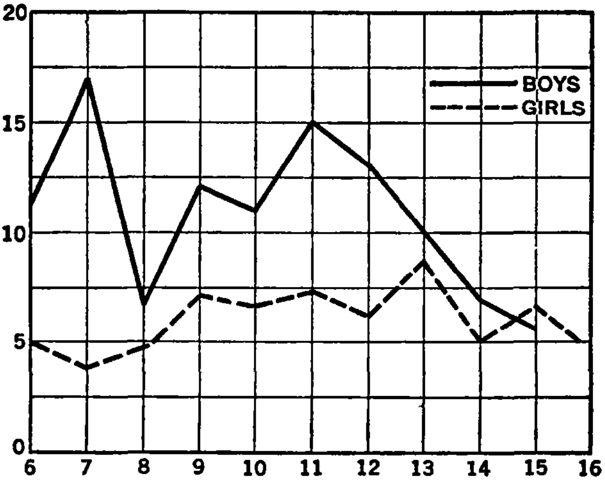

FIG. 44.—VARIATION OF UNDESIRABLE SCHOOL BEHAVIOR WITH AGE IN BOYS AND GIRLS.

The scores combine the frequency and gravity of the offenses of 800 school children as rated by their teachers. The higher the score the greater the undesirability. (From M. V. Haggerty—"Incidence of Undesirable Behavior in School Children," *Journal of Educational Research,* Sept., 1925.)

School misconduct and intelligence. In a study of public school children in Minneapolis, Haggerty[5] secured reports on 800 children, rated by their teachers, who also reported for each child the type of misbehavior and its frequency in each case. Behavior scores were computed, taking into account the commonness of each offense, and the frequency of its occurrence in a given child. On the basis of commonness, acts were rated 1, 2 or 3. On the basis of individual repetition, an act appearing only once or twice was rated 4, an occasional appearance 6 and a frequent appearance 7.

Thus stealing was weighted 3, in seriousness; a given boy who stole *frequently* would receive a misconduct score of 3 × 7 or 21. In this way misconduct scores for each child could be secured, and also the frequency of misbehavior could be separately studied.

The following graph (Fig. 45) shows the percentage of children at different mental levels (I.Q.) manifesting behavior problems, the total number of cases that were considered being 484 children.

The graph is much like the normal curve of distribution for intelligence, only turned upside down. That is, the smallest percentage of misconduct is found at 100 I.Q., and as we go above and below this average level, behavior problems increase in both directions. It is the low and the high intelligence quotients that go with school misbehavior as judged and rated by teachers, and the lower and higher the intelligence the greater the percentage of misbehavior. The increase is most prominent in the case of those with lower than average intelligence.

Study of the cases shows also a difference between the two groups, inferior and superior. "In the case of the more intelligent children the data show that a high behavior score is due to the greater frequency of the less serious forms of behavior. A high score in the other direction is usually due to the presence of the more serious acts, as well as to their greater frequency."[6]

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[5] *Ibid.* Haggerty was assisted in this work by Wickman, whose later study we have already considered.

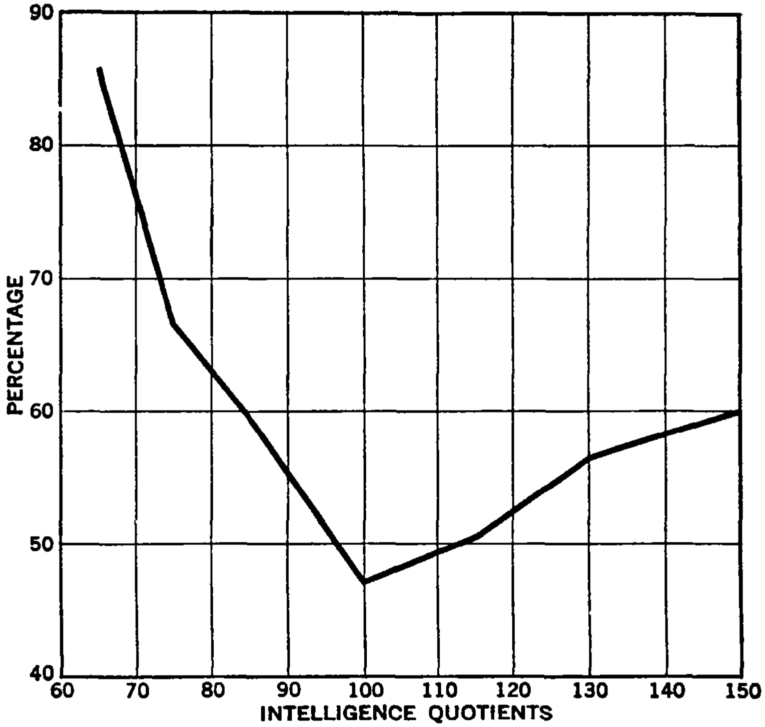

Fig. 45.—Per Cent of Children Manifesting Behavior Problems at Different Levels of Intelligence. (From Haggerty.)

Considering the scores, rather than the frequency of misbehavior, gives a table for the familiar classifications of intelligence as shown on the following page.

The average misbehavior score does not vary much for normal and superior children in this group. But the graph for frequency of misbehavior shows clearly enough that school misconduct may be expected, in its minor forms, from the superior more often than from the average. The school would appear, in its arrangements, demands, and standards, to be best suited to accommodate the normal or average child, and perhaps this is as it should be, since it is these who are there in overwhelming number.

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[6] Haggerty, *op. cit.*, p. 114.

I.Q.	Classification	Average Behavior Score	Number of Cases
Above 140 ..	Near genius or genius	7.4	5
120—140	Very superior	5.0	62
110—120 .	Superior	6.5	87
90—110	Normal	7.2	236
80— 90 ...	Dullness	13.5	62
70— 80 ...	Border line	14.6	27
Below 70 ..	Definite feeble-mindedness	36.1	7

The obvious explanation of the occasional misconduct of the bright pupil is to be found when the nature of those offenses scored only 1 in gravity is considered. They were: disinterest in school work, defiance to discipline, marked overactivity, lying, unnecessary tardiness, and cheating. That is, they are in the main offenses that grow out of lack of interest in what the school has to offer, idleness and restlessness because of the easiness of the tasks, and negativism and resistance toward the agencies responsible for their distress.

It is in the group with inferior intelligence that the graver offenses were most likely to occur: Weight 2—temper outbursts, unpopularity, bullying, speech difficulty, imaginative lying; and Weight 3—stealing, masturbation, truancy, obscenity.

Numerous studies have been made of groups of juvenile delinquents, and of their characteristics as compared with non-delinquent children. Among other differences of importance, a difference in intelligence between the two groups on the whole is evident. But it is also significant that the range of intelligence among the delinquents is great, and occasional cases may be found high up on the scale. The following graph[7] shows the distribution of intelligence quotients of over 1,200 juvenile delinquents, as measured by the Stanford-Binet scale. It will be seen that about three-fourths of these cases rate below I.Q. 100.

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[7] From W. Healy, *Practical Value of Scientific Study of Juvenile Delinquents*, Children's Bureau Publication, No. 96, Washington, 1922.

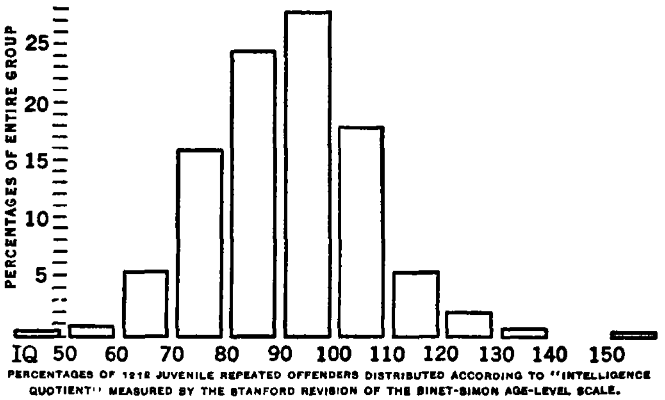

Fig. 46.—Distribution of I.Q.'s of Repeated Offenders. (From Healy's *Practical Value of Scientific Study of Juvenile Delinquents.*)

The incidence of truancy. The relation between mental dullness and truancy, suggested in Haggerty's study, is borne out by other investigations of this sort of school misconduct. In a statistical study of 102 truants in California schools, Clark found that 83 per cent of the cases were below average in intelligence, 15 per cent at average, and only 2 per cent rated superior. The distribution is shown in the accompanying graph.

The usual schools are poorly suited to the dull, and they know it and would if possible avoid the place of their discomfiture. Even if the school were better suited to them, in terms of their future, it is doubtful if this remote prospective reference would prevent truancy.

The usual school in the past has made little provision for the bright and has been almost as poorly suited to their talents as to those of the dull. But the bright are alert to take every possible advantage of the opportunity offered; they are also under better home supervision which exacts school attendance. Dull parents as well as dull pupils make for truancy. And on the whole the bright have ever been able to make for themselves a better opportunity than the fixed program called for —the encyclopedia, the maps, the books are there; the more advanced classes are sometimes doing interesting things.

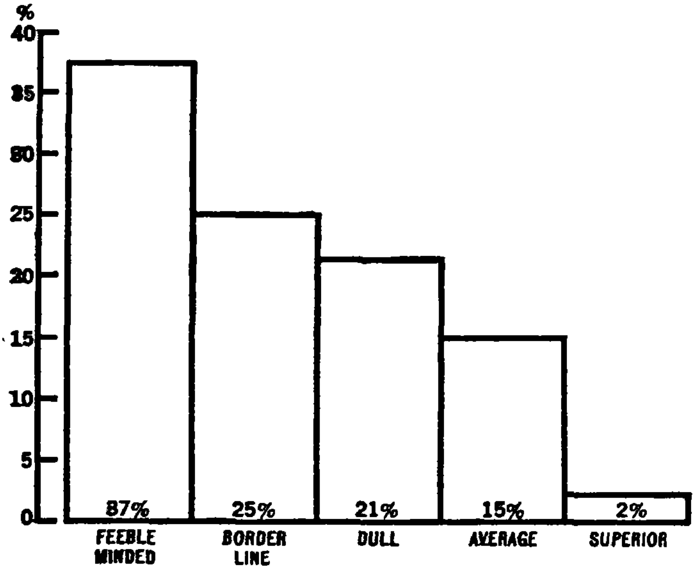

Fig. 47.—Percentage of Truants of Different Degrees of Intelligence.

(From W. W. Clark.—"A Statistical Study of 102 Truants," *Journal of Delinquency*. Vol. 3, No. 5.)

There are many factors involved in any given case of truancy, and these cannot be forgotten. But the first thing to look for back of deliberate truancy is inferior ability to comprehend what goes on at school.

The misrepresentation of facts. Lying is of course no peculiarity of school children. Nor is there reason to suppose that the motives back of it are in general different in children and adults. Misrepresentation of facts, untruthfulness, stands relatively high among the reported misdemeanors of school children. Again, any understanding of such behavior must rest upon insight into the individual and the circumstances. But some knowledge of the probable motivation of such conduct is useful. Several studies of the non-experimental kind have been made.

A recent inquiry[8] into the lies of children at the usual age of school entrance (six years) suggests several such general considerations. Among a list of acts occurred 289 cases of clearly intentional misrepresentation. From observations recorded by the parents, brothers or sisters, or others who observed the act, an analysis was made of the influences apparently responsible for it. These were classified into convenient categories in order to discover their relative importance, as causes, occasions or excuses for misrepresentation. The following table gives the general classification.

Occasion	*Percentage of 289 Situations in Which Element Occurred*
Some irregularity committed	56.7
Obtaining, keeping or caring for property was frustrated	17.9
Competitive activity	17.9
Unpleasant experience imposed	12.4
Pleasant experience frustrated	11.7
Person available to help	4.1
Others, enjoying with child the activity frustrated	3.8
Other person angry	2.0
Others urging the child	1.7
Attention to be obtained	1.4
Opportunity to amuse others	1.3
Obligations conflicting	1.0
Other circumstances abetting	11.4
Other circumstances alleviating	0.3

In over 97 per cent of the cases one of the following five elements was present in the motivating situation:

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[8] A. M. Carmichael, "To What Objective Stimuli Do Six-Year-Old Children Respond with Intentional Misrepresentation of Facts," *Journal of Genetic Psychology*, 1928.

(*a*) The child had committed an irregular or non-conforming act and was called upon to account for it.
(*b*) He wanted to obtain, keep or care for property.
(*c*) He was competing with another.
(*d*) He was forced by another into performing some act.
(*e*) His activity was being frustrated by another.

Intentional misrepresentation, even on this young level, serves the usual adult purposes. It is a technique of self-defense. Perhaps the most useful conclusion in connection with such an analysis would be that a search for the motivating irritant or danger, actual or imagined, should be the first step. Other studies, however, show that there are marked individual differences in liability to this mode of self-defense, so that some knowledge of the correlations of deceit with other traits may be useful.

Experimental studies of deceit. An experimental program over a number of years, directed toward the investigation of character traits, has been reported by May and Hartshorne.[9] Some 11,000 school children, ranging in age from eight to sixteen years, were submitted to ingeniously devised situations and tests, which offered opportunity for deceit, lying, or stealing. No attempt was made to *provoke* such conduct, but situations were so arranged that it could be *known* if indulged in.

> The whole battery of deception tests contains 22 opportunities to cheat in classroom work, 4 opportunities in athletic contests, 2 in party games, and 1 in school work done at home. The lying tests consist of 36 questions in one case and 10 in the other which may be answered falsely; and the stealing tests offer 2 chances to steal money and 1 to steal small articles.

The reaction of the pupils to these situations were learned without their knowing of this fact, or that they were being tested. Scores for tendency to show the three sorts of undesirable behavior could be computed, and these combined, compared, and correlated with numerous other sorts of information secured concerning all of the children.

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[9] From Hartshorne and May, *Studies in Deceit* (1928). By permission of The Macmillan Company, publishers.

In the following brief summary an attempt is made to give the net outcome of the relationships of deception in these various forms with numerous other variables in school children. A volume of over seven hundred pages is required to give all the details.

The relationship of deception to:

1. *Age*—"Older pupils are slightly more deceptive" than younger.
2. *Sex*—"Sex seems to make no difference."
3. *Intelligence*—"Those of higher levels of intelligence deceive definitely less than those of lower levels" at a given age.
4. *Emotion*—Children showing emotional maladjustment are more likely to deceive.
5. *Physical Condition*—"Not related to deception."
6. *Socio-economic Background*—"Children from the higher socio-economic levels deceive less."
7. *Cultural Background*—Better cultural background goes with less deception.
8. *Home Conditions*—Greater deceit goes with miscellaneous home conditions that are discordant, impoverished, and bad.
9. *Nationality*—Deception least in children of parents who were born in North Europe or America.
10. *Kinship*—"Deception runs in families to about the same extent as eye color, length of forearm, and other inherited structures."
11. *School Grade*—In most tests no difference; in some a steady increase from 6th to 8th, but grade 5 is the most deceptive.
12. *Grade Retardation*—"Children over-age for their grade cheat more."
13. *School Achievement*—Mental age being taken into account, no difference in relation to school achievement.
14. *Deportment*—"High deportment marks are associated with less cheating."
15. *Associates*—Friends and associates resemble one another.
16. *Movie Attendance*—Those going oftener cheat slightly more.
17. *Teacher Influence*—Less cheating when relation between the teacher and the pupils is free and cordial.
18. *Organizations*—Attendance upon and membership in organizations purporting to teach honesty does not seem to make any difference in the scores.
19. *Suggestibility*—This as measured by one form of test shows greater resistance correlated with less deceit.

The investigators conclude that there is no unitary trait such as "honesty." Deceit is highly specific to the situation; those who cheat in one situation do not in another. Although correlations are found, and general influences such as intelligence, age, home background make a measurable difference, the situation itself is also a potent factor in determining the behavior. If there is transfer, it is far from complete.

> The concomitants of deceit are, in order of their importance, (1) classroom association; (2) general personal handicaps, such as relatively low I.Q., poor resistance to suggestion, emotional instability; (3) cultural and social limitations in the home background; (4) such other miscellaneous facts as are loosely correlated with deception.
>
> The main attention of educators should be placed not so much on devices for teaching bonesty or any other "trait" as on the reconstruction of school practices in such a way as to provide not occasional but consistent and regular opportunities for the successful use by both teachers and pupils of such forms of conduct as make for the common good.[10]

School behavior and delinquency. The bearing of school misbehavior on the social adjustment of individuals is clearly suggested by the remarks of Burt,[11] a careful student of juvenile delinquency.

> Delinquency I regard as nothing but an outstanding sample—dangerous perhaps and extreme, but none the less typical—of common childish naughtiness. Just as the study of the mentally deficient has advanced both our knowledge and our teaching of the average boy and girl, just as the study of the hysterical has explained much that was unintelligible in everyday behavior, so, I am convinced, the psychology of the young criminal will throw great light upon the daily disciplinary problems of the classroom and upon the conduct or misconduct of the difficult child.

Following up this suggestion, Burt made a comparative study of a group of 200 juvenile delinquents with a control group of "400 non-delinquent children of the same age, of the same social class, living usually in the same street and attending the same school." All the individuals in both groups were examined, tested, observed, rated by teachers, in the same way. When an effort was then made to determine the relative frequency with which various other factors were found associated with delinquency, the following conclusions were reached:

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[10] *Ibid.*, p. 412*ff.* By permission of The Macmillan Company, publishers.

[11] Cyril Burt, *The Young Delinquent* (D. Appleton & Co., 1925).

> Judged by the coefficients, the following proves to be the order of importance of the various conditions we have reviewed:
>
> 1. Defective discipline
> 2. Specific instincts
> 3. General emotional instability
> 4. Morbid emotional conditions, mild rather than grave, generated by or generating so-called complexes
> 5. A family history of vice or crime
> 6. Intellectual disabilities, such as backwardness or dullness
> 7. Detrimental interests, such as a passion for adventure, for the cinema, or for some particular person, together with a lack of any uplifting pursuits
> 8. Developmental conditions, such as adolescence or precocity in growth
> 9. A family history of intellectual weakness
> 10. Defective family relationships—the absence of a father, the presence of a stepmother
> 11. Influences operating outside the home—as bad street companions and lack or excess of facilities for amusement
> 12. A family history of temperamental disorder—of insanity or the like
> 13. A family history of physical weakness
> 14. Poverty and its concomitants
> 15. Physical infirmity or weakness in the child himself
>
> If we consider major causes only . . . among personal conditions, the most significant are, first, the mental dullness which is not severe enough to be called deficiency, and secondly, the temperamental instability which is not abnormal enough to be considered pathological. Among social conditions by far the most potent is the family life, and next to it, the friendships formed outside the home. These four conditions are paramount.

If misbehavior is similarly motivated inside and outside of school, the teacher and administrator may usefully consider this list of probable causal factors, at least as a guide in the study of any individual school problem. It may also be said that the general rules or principles recommended by students of juvenile delinquency can usefully be expanded and applied to the earliest manifestations that appear in school conduct. Those principles suggested by Burt are:

1. All young persons who show delinquent tendencies should be dealt with at the earliest possible age.
2. The problem of delinquency in the young must be envisaged as but one inseparable portion of the larger enterprise for child welfare.
3. The delinquent himself must be approached individually as a unique human being, with a peculiar constitution, peculiar difficulties, and peculiar problems of his own.
4. The remedies . . . will be adapted, not to the nature of the offense, but to the nature of the factors provoking it.
5. Aim at prevention as well as at cure.

PROBLEMS

1. What various acts would you consider school misconduct on the part of members of this class? How do they compare with the misbehaviors cited in the case of elementary pupils?
2. To what extent do you think the school should be responsible for training in honesty, cleanliness, truthfulness and politeness?
3. Describe some marked case of negativism or stubbornness in a very young child. How do you account for it?
4. Observe over a period of time some child in the "questioning age" and try to decide what chief factors are responsible for the endless interrogation.
5. Describe the "imaginary companions" or other phantasy experiences of your own childhood. What appears to have been their motivation?
6. Do you believe that "Children recapitulate the history of the race" in their growth and development? What criticisms or corrections does such a statement warrant?
7. Describe some "crush" you have observed in school children, and do what you can to explain such behavior. Under what circumstances are "crushes" most likely to develop?
8. What do you consider the four most difficult problems commonly experienced by adolescents?
9. What effect has the "progressive" movement in modern edu-

cation had on the teacher's concern over and responsibility for "deportment"?

10. Find some survey of the mental and physical characteristics of a group of juvenile delinquents and consider in what ways they are distinguished from other children.

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CHAPTER XXI

THE PSYCHOLOGY OF THE TEACHER

Up to this point in our account, much attention has been given to the psychology of the learner, his individual characteristics, his needs and distresses, his methods of learning, and the outcomes of instruction. There is also a psychology of the teacher. Such topics as the following might belong under such a heading.

1. Teachers as a class, their characteristics and individual differences
2. The traits of mind and character desirable in teachers, as seen by supervisors, pupils, patrons and others
3. The relation of the teacher's characteristics to such variables as subject matter, pupils, methods of instruction
4. Methods of rating the teacher and of measuring the effectiveness of teaching
5. Psychological questions connected with such general topics as morale, motivation and professional attitude, professional ethics, social relationships of teachers and their place in the community

On many such topics nothing could be given but vague generalities, applicable equally well to the members of various other professional groups. On other topics specific inquiry has at least been initiated. A brief survey of some of these results will serve to call attention to the significance of some of the problems in the total enterprise of education.

Distribution of the pupil population. Since the qualities desirable in a teacher may depend to some degree on the nature, age and educational level of the pupil, it will be useful first to inquire how pupils are distributed in these respects, at least in the public schools, where reasonably representative statistics may be secured. The following figures[1] show how the public school enrollment of the United States was distributed by grades in 1920.

Level	Grades	Percentage of total
Primary grades . . .	1—2	32.3
Intermediate	3—6	43.0
Junior high school	7—9	19.2
Senior high school	10—12	5.5

Of the total enrollment, 75 per cent are in the elementary grades, grades 1 to 6, which therefore may be said to occupy approximately three-fourths of the public school teachers. Distributions of teachers separately confirm this. These grades would include chiefly pupils ranging in age from six to fourteen years. Pupils in these levels are very heterogeneous in ability, interest, background and outlook, since practically the whole range of intelligence is represented, and the whole population sampled.

The reduction in numbers on the high-school levels, aside from the slight influence of mortality, is due primarily to selection on the basis of intellectual ability and interest. Social and economic factors also play a rôle in "elimination," but these are closely correlated with intellectual level and consequent interest in education. Social and economic advantages may keep dull and uninterested pupils in school or may cause able pupils to drop out in favor of vocational activity. But the fact remains that the higher the educational level, the greater and the more homogeneous the intelligence of the pupils, and also of their parents.

Shifts in the distribution of the school population have been due chiefly to increasing registration on the higher levels. Thus in the 50 years since 1870 the percentage of the population of the United States enrolled in high schools has increased tenfold, the increase in the elementary school being slight. From 1890 to 1925 high-school enrollment increased tenfold, college enrollment fivefold, while the total population and attendance at elementary schools scarcely doubled. The accompanying graph shows these curves of increase.

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[1] Adapted from Bagley and Keith, *An Introduction to Teaching* (Macmillan Co., 1924).

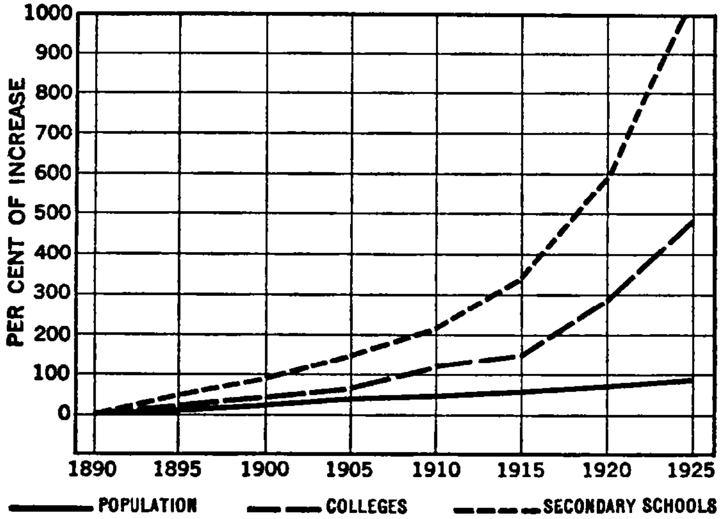

Fig. 48.—Increase of School Population.

Conditions in this respect also vary in different parts of the country. Illiteracy statistics among the states of the Union suggest some of these differences. In 1920 the number of illiterates in the 49 states ranged from 1 to 22 per cent of the respective populations. Such conditions change from period to period. But they enable us to conclude that:

(*a*) About three-fourths of the teachers will be occupied with pupils below the 7th grade.

(*b*) This majority of teachers will be occupied with pupils whose heterogeneity of ability and interest is great.

(*c*) On higher levels the number of pupils declines notably, as does also the degree of heterogeneity.

The gradual elimination of pupils as the educational level advances has been studied by several investigators.[2] An interesting curve showing this selective operation (combined with other influences) resulted from the statistical analysis of records of men in the draft army in the United States during the World War.[8] The following conclusion is quoted from the official report of these data:

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[2] L. P. Ayres, *Laggards in Our Schools*, 1909; also Cleveland Educational Survey, 1917; G. D. Strayer, *Age and Grade Census of Schools*

> The facts reported by white recruits may be stated in this form: Of 100 white recruits who entered the first grade in this country, 95 remained in school till grade 2, 92 till grade 3, 87 till grade 4, 79 till grade 5, 70 till grade 6, 59 till grade 7, and 45 till grade 8; 21 of them entered high school, 16 kept on until the second year, 11 till the third, and 9 of the 100 graduated from high school; 5 of these entered college, and 1 graduated from college.

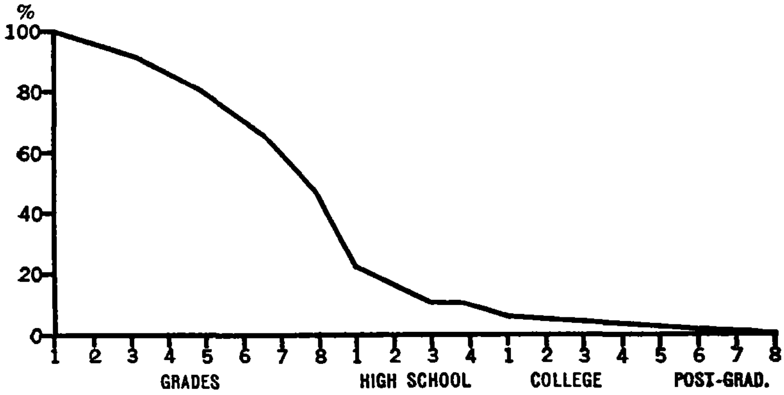

FIG. 49.—ELIMINATION FROM SCHOOL.

Showing the number, of 100 entering the first grade, who continued in school to graduate from various later school years. (From National Academy of Science Memoirs, XV, 1921.)

These figures approximate very closely those previously estimated in connection with studies of elimination made by school men. The curve is shown in the accompanying graph.

Socio-economic background of teachers. Of every 140 people in the country one is a teacher. There are about seven

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and Colleges, United States Bureau of Education Bulletin, No. 5, 1911; E. L. Thorndike, *The Elimination of Pupils from School*, United States Bureau of Education Bulletin, No. 4, 1907.

[8] "Psychological Examining in the United States," *National Academy of Science Memoirs*, Vol. 15, 1921, p. 762.

times as many teachers as lawyers and about four times as many teachers as physicians. Are there certain characteristics that decide which of the group of 140 people is to be the teacher?

For one thing, in American public schools, and particularly on the elementary level, teachers are likely to be young. The median age of elementary teachers in New York State rural, village and small city schools in 1921 was 29 years. In larger cities the median was about 5 years older.

Teachers, especially elementary teachers, tend to come from relatively large families with very modest incomes. Coffman[4] found in 1911 that the typical woman elementary school teacher came from families with four children and an annual income of considerably less than $1,000. The typical elementary school teacher in large and progressive communities in America is a high-school graduate with, in about half the cases at present, two years of normal school training. In smaller communities such teachers are younger, less prepared, and remain teachers for a shorter period.

High-school teachers on the whole are older; they are usually college graduates; they come from families that are smaller and better situated socially and economically. A larger number, about one-third, are men. Administrators, supervisors, and technical experts are, of course, still older, better trained, and remain in education in a more permanent, professional way.

None of these sociological facts however tell us anything about the actual or desirable qualifications of teachers. Even the domestic, social, economic and educational facts mean little unless we are able to compare them with similar data from dentists, salesmen, railroad engineers and other occupational groups, and no such comparisons have been found.

What are the desirable traits of teachers? Much the same is to be said of the "traits" that have been announced as desirable. An early study of teachers' traits[5] may serve as a typical attempt. Administrators were asked to indicate the ten qualities judged to be most important in a good "teaching personality." The traits suggested were ranked on the basis of frequency of mention. Teachers were then rated in the ten highest traits and also for general teaching personality. The rank-order of the ten most important qualities was as follows:

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[4] L. D. Coffman, *The Social Composition of the Teaching Population* (Teachers College Bureau of Publications, 1911).

1. Address
2. Personal appearance
3. Optimism
4. Reserve
5. Enthusiasm
6. Fairness
7. Sincerity
8. Sympathy
9. Vitality
10. Scholarship

There can be no doubt that these are desirable traits—they are among the sterling virtues of mankind. But are they not as important for railroad conductors, life insurance salesmen, soldiers and prison wardens as they are for teachers? And would not the rank-order be much the same? Does such a list of vague and unmeasurable *qualities* actually serve to distinguish teachers, or even good teachers, as a group, from other vocational groups? Certainly not.

Another enumeration of "qualifications for teaching," each being discussed and illustrated in detail[6] is:

1. Personal appearance
2. Health (vitality, physical control)
3. Social intelligence (address, tact, sympathy, leadership)
4. Moral qualities (sincerity, loyalty)

Again the traits would be much the same if enumerated for successful cowboys, clergymen, peddlers or theater ushers, instead of for teachers. Such enumerations do not serve to identify teachers, however useful they may be in inviting attention to factors that any teacher, as a human being, should seriously cultivate, or, if possible, inherit.

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[5] F. L. Clapp, summarized in W. C. Bagley, *School Discipline* (Macmillan Co., 1914).

[6] Bagley and Keith, *An Introduction to Teaching* (Macmillan Co., 1924), Ch. xi.

Teacher-rating cards and scales. Attention to such matters is made more specific, if not more accurate, by the use of "rating cards," for self-rating or for the description of others.[7] The use of carefully prepared rating scales often serves only to give a false sense of precision to estimates of character. Aside from the indeterminateness of the "traits" indicated by words, the validity of such judgments varies with the trait, with the judge, with the degree and mode of acquaintance.

The following table illustrates some of these variations. Seven traits are named, and ranked according to the closeness of agreement of different judges when rating the same individuals.[8] Three situations are represented: (*a*) teachers judging other teachers, (*b*) students judging other students, and (*c*) students judging teachers.

Trait	Teachers Judging Teachers	Students Judging Students	Students Judging Teachers
	Traits Ranked According to Closeness of Agreement, Greatest Agreement Being Rank 1		
Efficiency	1	2	5
Energy	2	4	3
Leadership	3	3	7
Independence	4	1	6
Coöperativeness	5	6	4
Cheerfulness	7	5	2
Kindliness	6	7	1

Teachers, judging other teachers, agree most closely in their estimates of efficiency and energy, and agree least closely on cheerfulness and kindliness. When, however, *students* judge teachers, they agree most closely on cheerfulness and kindliness, just those traits on which teachers agreed the least. Who then is to be the judge of the traits of the teacher? In the absence of scales and tests for the measurement of character traits, estimates only are available. Not only do we lack a list of qualifications to be desired; we lack also a valid and reliable method of identifying those traits even if we had such a list.

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[7] H. O. Rugg, "Self-Improvement of Teachers through Self-Rating," *Elementary School Journal,* Vol. 20, 1920.

[8] H. L. Hollingworth, *Vocational Psychology and Character Analysis* (D. Appleton & Co., 1929).

The importance of qualifications on the part of teachers cannot be denied, however far we now are from being able to give final verdicts. A step in the right direction may be to survey briefly some of the studies that have been made of the alleged qualifications of teachers on different educational levels.

Various "rating cards" have been proposed for the self-rating of teachers and their judgment by supervisors. An early form of such a rating card [9] listed seven groups of characteristics, each group being assigned a number of points, a perfect score being 100 points. The characteristics, and suggested point values were as follows:

	Points
1. Physical efficiency	12
2. Moral-nature efficiency	14
3. Administrative efficiency	10
4. Dynamic efficiency	24
5. Projected efficiency	6
6. Achieved efficiency	24
7. Social efficiency	10
Highest possible score ...	100

The traits themselves are highly indeterminate, and the values assigned to the group arbitrary, and no means of measuring were available. Such a list, however, served to call attention to the possible importance of some attempt at detailed analysis.

In a later form rating scales were proposed [10] with the traits

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[9] E. C. Elliott, *A Tentative Scheme for the Measurement of Teaching Efficiency,* 1910; also "How Shall the Merit of Teachers be Tested and Recorded," *Educational Administration and Supervision,* May, 1915.

[10] H. O. Rugg, "Self-Improvement of Teachers through Self-Rating," *Elementary School Journal,* Vol. 20, 1920.

SAMPLE SECTION OF SCHUTTE SCALE FOR RATING TEACHERS *

DIRECTIONS FOR USE OF SCALE

It is not intended that all teachers be marked in all qualities on this scale, but all teachers should be marked under each of the five large divisions (Personal and Social Qualities; Coöperative Qualities; Leadership; Scientific and Professional Attitude; and Teaching Ability). The subdivisions are given to aid the rating officer in his analysis. He should check as many of the subdivisions as he can, but only those for which he has an adequate basis for judgment.

SAMPLE RATING

Trait	Far Below Average	Below Average	Average	Above Average	Far Above Average	Score	Comment
	Lowest 5%	Next 25%	Middle 40%	Next 25%	Highest 5%		
	E	D	C	B	A		
	1	2	3	4	5		
I. PERSONAL AND SOCIAL QUALITIES:							
1. Is she personally likable—does she attract people?			✓			*3*	*Good-looking*
2. Is she free from distracting peculiarities?				✓		*4*	
3. Does she meet people easily?		✓				*2*	*Lacks grace*
4. Is she careful in dress and social niceties?			✓			*3*	
5. Is she tactful in dealing with pupils and patrons?			✓			*3*	
Total I Scores		*1*	*3*	*1*		*15*	*Avg. I Score 3*

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* From T. H. Schutte, *Scale for Rating Teachers* (copyright, 1923, by World Book Company, Publishers, Yonkers-on-Hudson, New York).

divided into five categories. The teacher was to rate herself for these traits; similar ratings by supervisors were to be made, and for this purpose the man-to-man type of rating scale was proposed in the form then being experimented with in personnel work in industry. The categories in this case were:

1. Skill in teaching
2. Skill in managing a class
3. Teamwork qualities
4. Growth and up-to-dateness
5. Personal and social qualities

In another "scale for rating teachers"[11] that has been much used, about 90 questions concerning various traits are classed under five chief categories, as follows:

1. Personal and social qualities (18 questions)
2. Coöperative qualities (11 questions)
3. Leadership (11 questions)
4. Scientific and professional attitude (19 questions)
5. Teaching ability (27 questions)

The scale was constructed "largely from the questions asked concerning candidates and from questions asked candidates in conference." Each trait is marked on a five-step scale, and the separate ratings may be combined to give a rating for the main category. The accompanying short section of a scale for the first five questions of the first general category will serve to illustrate the method of checking and the type of analysis.

The chief recommendations suggested are that the scale be used:

1. To single out qualities for improvement
2. To analyze a teacher for employment and promotion
3. As an aid in supervision of teachers by providing a concrete basis for conference
4. For use by classes in education to point the way to analysis

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[11] T. H. Schutte, *Scale for Rating Teachers* (World Book Co., 1923).

5. As a guide in observing others for self-improvement
6. As a guide and basis for discussion in teachers' meetings to produce consciousness of details and teaching merit

Correlation of traits as rated in teachers. In one of the earliest studies[12] of teachers' traits, comparison was made between estimated teaching efficiency and scholarship in the studies pursued in normal school by the teachers before the period of service in which their efficiency was judged. No important correlation was found, the correlation being positive but averaging only about 30 per cent with various subjects studied. This was true even in the case of professional subjects, closely related to the work of teaching. Experience, after the first year, was also found to make very little difference in the judged efficiency.

In another of the earlier studies, teachers were judged for each of forty-five named traits, and ratings of teaching efficiency were also secured.[13] All these ratings were intercorrelated, and the correlations were positive and high. But analysis shows that the estimates of the separate traits were so dependent on "general estimates" that they had little meaning. A generally good impression would lead to high ratings in all the special traits; judgments for each trait showed merely the general opinion of the judges for the person as a whole and hence would not differ strikingly from the estimate of general efficiency.

In a later study[14] a large number of teachers were rated by one another for a number of specific traits, and also for "general teaching ability." Statistical analysis of the results showed that the general estimate so influenced the ratings for specific traits that "judgments of particular traits are in themselves of little practical use."

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[12] W. L. Meriam, *Normal School Education and Efficiency in Teaching*, Contributions to Education, No. 1 (Teachers College, Columbia University, 1906).

[13] A. C. Boyce, *Fourteenth Yearbook*, National Society for the Study of Education, Part IV (1915).

[14] F. B. Knight, "Qualities Related to Success in Teaching," Contributions to Education, No. 120 (Teachers College, Columbia University, 1922).

The ratings for general teaching efficiency were also correlated with age, experience, a handwriting test, intelligence tests, scholarship in normal school, amount of professional study since beginning to teach, and score in a test of professional knowledge. For the group as a whole the only correlations at all significant were those with scores in the professional test and amount of professional study. It was concluded that interest in the work of teaching was the main determinant of efficiency, and that it was this interest that was also responsible for the professional study and the high score on a professional subject matter test.

The correlations of general teaching efficiency with score on a one-hour intelligence test as shown in the following table have some interest.

Town and Grade	Correlation of Intelligence with General Teaching Ability as Judged by:	
	Other Teachers	Supervisors
Town A		
Elementary Grades	−.10	.12
High School	.38	.35
Town C		
Elementary Grades	.31	.23
High School	.55	.48

Teaching efficiency and intelligence. The correlations of teaching efficiency, as rated, with intelligence by test are in no case high, but they are in all cases considerably higher in the case of high-school than in the case of elementary school teachers. The conclusion was suggested that "In elementary school teaching, even in the most routine work, intellect can be used and is used, but patience, industry, sympathy, and other qualities are relatively of greater importance than intellect." In the case of high-school work, the pupils are older, the subject matter is more complex, and the methods are less conventionalized, so that intelligence is apparently a more important factor. The fact that the correlation is no higher than it is may be due in part also to the unreliability of the ratings for teaching efficiency. The number of cases studied in this investigation is however not large enough to give more than suggestive value to the results.

In a later study [15] 780 elementary school teachers were rated by supervisors after the first term of work under contract. The various ratings and other measures were correlated, and by elaborate statistical technique the relative contribution of several factors to teaching efficiency was calculated. Partial and multiple correlation techniques were used, and regression equations developed giving due weight to each variable. When rated teaching was taken as the "criterion" and a formula developed for the prediction of this ability, the following traits were shown to stand in the order given, and the relative weights of these factors in the prediction formula are shown by the figures given.

1.	Grade as a student teacher	1.403
2.	Marks in professional normal school subjects	.915
3.	Marks in academic subjects	.115
4.	Physique	.085
5.	Record in secondary school	.038
6.	Intelligence, by test	.004

Again, in the case of elementary school teachers, the tested intelligence is assigned the least weight, and the highest values go to factors presumably reflecting interest in the work—*viz.* —success as a student teacher and grades in professional educational courses in training.

Intelligence status of teachers. The following tabulation of the scores in Army Alpha intelligence test of the graduates of eight State Normal Schools is given:

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[15] F. L. Whitney, *The Prediction of Teaching Success* (Public School Publishing Co., 1924).

Score	Cases
195—204	1
185—194	6
175—184	15
165—174	37
155—164	74
145—154	96
135—144	127
125—134	109
115—124	109
105—114	72
95—104	60
85— 94	33
75— 85	18
65— 74	6
55— 64	1
Below 55	1

The median value falls just between a rating of A and one of B as these tests are rated for the population at large. This is also about the average of the median scores from the students of twenty-eight colleges from which Army Alpha data have been collected.[16]

Data on Army Alpha from a large middle western university show intelligence scores as follows for students in different departments: [17]

Department	Median	Cases
Graduate school	157	152
Commerce	147	52
Medicine	142	141
Law	142	141
Engineering	141	1392
Agriculture	133	859
Arts college	133	1966
Education	133	382
Pharmacy	125	109
Dentistry	115	152
Veterinary medicine	112	93

The students of education here score very much as do those in the normal schools; the median is the same as for students in the liberal arts college; it is, however, exceeded by several of the professional groups.

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[16] See, for such data, R. Pintner, *Intelligence Testing* (Henry Holt & Co., 1931), Ch. xii.

[17] *Ibid.*, p. 297.

The following data are given for scores in Army Alpha for high-school students in various cities (median scores):

Class	Madison	Rockford	Sioux City	Omaha Central
Seniors	121	124	138	135
Juniors	122	120	130	132
Sophomores	109	107	122	122
Freshmen	96	94	108	107

The average high-school freshman may be expected to score about 100 points; the increase beyond this level to the senior year is partly due to growth, partly to selection of the more able students for academic survival. The average score of high-school seniors represents a value that will be little likely to change with age. This score is approximately the same as that of students of education in normal schools and education departments of our universities, as a group. We may therefore say that teachers appear to be drawn from the level of ability represented by those who have survived the usual school selection so as to attain senior status in good high schools.

That this group represents a high selection from the population at large is shown by the following ratings for the army test scores, the letter C representing average status.

Score in Alpha	*Letter Grade*
135—212	A
105—134	B
75—104	C plus
45— 75	C
25— 44	C minus
15— 24	D
0— 14	D minus

The measurement of teaching efficiency. A problem rather different from that of determining in a general way the desirable traits of teachers is that of measuring the actual efficiency of a teacher actually at work. It might be supposed that the best index of teaching effectiveness would be the learning accomplished by the pupils. But such a measure is not so easy to secure as might at first appear. In the first place the progress made by the pupils depends in part on their own native ability and the interest and zeal with which they begin their work. It depends on the adequacy of their preparation under the guidance of earlier teachers. It depends on various other influences in the school not entirely in the hands of the teacher, such as the curriculum and methods outlined or prescribed, the tradition of the school with respect to the importance of classroom work, the distractions offered by extra-curricular activities, and many other such features.

One method of measurement that has been proposed[18] is that of comparing the "accomplishment ratios" of the pupils at the beginning and end of a term of study. If standardized subject matter tests are used, and if the mental age of each pupil is also known, the accomplishment ratio (A.R.) for each pupil can be secured at the beginning of the year. This will be represented by a fraction, the numerator being the "subject age" and the denominator the "mental age" of the pupil. This will show how nearly he approximates what might be expected from a pupil of that ability. At the end of the term reëxamination in the subject matter and in mental age will afford a final accomplishment ratio. The difference between the initial and the final accomplishment ratios will represent the advance made during the year in accomplishment, and might be credited to the teacher.

Crabbs studied in this way eighty-seven teachers in the school system of a city of 10,000, with about 2,000 pupils, who were submitted to a systematic testing program throughout the year. Various systems of rating teachers were also employed, and the following conclusions were reached.

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[18] L. M. Crabbs, *Measuring Efficiency in Supervision and Teaching*, Contributions to Education, No. 175 (Teachers College, Columbia University, 1925).

1. Teaching efficiency cannot be judged by supervisors accurately enough to be of any practical use.
2. Teaching efficiency cannot be determined by testing a teacher's knowledge of modern educational ideas and practices.
3. Teaching efficiency *in special fields* can be measured accurately by means of the teaching efficiency formula (Final A.R.—Initial A.R.) without making much if any allowance for the pupils' I.Q.'s or initial accomplishment ratios.
4. Many aspects of teaching must be measured in this way before a sufficiently accurate measure of teacher efficiency for practical purposes can be secured.

Obviously, such a method must be used with great caution. If preceding teachers have brought pupils up to the level of a high accomplishment ratio (A.R.), little change in this ratio can be effected by even the best of teachers who follow them. It would be an excellent teacher who could *maintain* these high ratios, thus showing a zero change as between initial and final A.R. The method furthermore would seem to assume that the teacher alone was responsible for all that happened in the work of her pupils.

Such methods might be better measures of the efficiency of the school as a whole. The geography teacher might make her effort to increase the accomplishment ratios of her pupils in that subject, and her progress might depend very largely on what the reading teacher or the arithmetic teacher was doing in that line in her particular subject. Geography does not go on in one compartment of the pupil's mind and reading and arithmetic in other compartments. The net change in any subject may therefore reflect the efficiency of the total teaching experienced by the pupil. But to attach the merit or blame to the one teacher in whose work the change shows itself most strikingly cannot be said to be a wholly accurate measurement of this teacher.

Trade tests for teachers. In industry certain progress has been made in the devising of standardized information and performance tests for the measurement and prediction of trade skill. Efforts have also been made to use this procedure in the measurement of teaching aptitude. Such tests, objectively scored and capable of repetition and verification, are recommended as supplements to the conventional and for the most part unreliable methods otherwise available—such as the use of the interview, the photograph, the recommendation, and scholastic records and experience records.

In one such professional test[19] series of questions, to be answered by checking, are given under the following heads:

Title	Type of Items	Number of Items
1. Professional judgment .	5 response	28
2. Theory and practice of teaching	true—false	85
3. Reading comprehension ..	questions	25
4. Social information ..	4 response	24
5. School and class management ..	true—false	55
6. Professional information . .	true—false	33
Total number of items .		250

The test is prepared in the form of a booklet, and a total time of ninety minutes is required for administration. Standard scoring sheets are provided, and norms for interpretation for elementary and high-school teachers.

The norms show the percentage of teachers reaching different scores. The predictive value of the tests was determined by "correlating the scores on the tests with judgments of superintendents and supervisors who had observed the teaching efficiency of each teacher judged for at least nearly one school year."

In the case of elementary teachers, the test scores gave a corrected correlation of + .52 with such judgments. In the case of high-school teachers the correlation was considerably higher, + .75. These results confirm those previously referred to, to the effect that test performance is apparently less important as an index of teaching success in elementary teachers than in the case of high-school teachers.

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[19] J. E. Bathurst, F. B. Knight, G. M. Ruch and F. Telford, *Aptitude Test for Elementary and High School Teachers* (Bureau of Public Personnel Administration, Washington, D. C.).

The following abbreviated table of norms shows the way in which any given teacher could be located in the proper decile of the group (based on 1007 cases):

Composite Scores, Elementary Teachers [20]

Percentage Reaching or Exceeding the Given Score	*Points*
10	140
20	130
30	123
40	116
50	110
60	104
70	98
80	91
90	79

Student opinion of teachers. In the absence of reliable methods of determining precisely the merit of different teachers, there is no objective criterion for estimating the validity of student opinion. Presumably pupil opinions would also be determined by the halo effect of general impressions of liking or disliking, whatever the trait in question. Few studies are available of quantitative estimates of teachers by pupils, or of qualitative analyses of teachers by pupils. The following study [21] will serve to illustrate a type of investigation that might profitably be carried further.

Guthrie investigated ratings of college teachers by their students. When eighty-seven teachers were ranked by five or more students each, in comparison with other teachers, the ranks shown on alternate cards were taken to constitute two series of such judgments. The two series correlated only to the extent of + .26, a low and unreliable coefficient of resemblance. "Knowing the rank assigned to a teacher by one student, the rank assigned him by any other single student could be predicted with an error 96 per cent of the error of a pure guess." Pupils, in other words, differ very much in their estimates of the same teachers.

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[20] High-school teachers (551 cases) score about 5 points higher than elementary school teachers in this test.

[21] E. R. Guthrie, "Measuring Student Opinion of Teachers," *School and Society*, February 5. 1927.

When half the students' ratings were averaged to make up one series and the other half to make up another series of values, the correlation was + .79 between the two series. That is, when an average of eight or more student opinions is compared with the average opinion of another group of 8 or more, something like a stable impression appears to emerge. A correlation of + .79 means about the same degree of resemblance as exists between twins in physical characteristics.

When the average rankings by the whole class at the beginning of the year were compared with similar averages one month later, the correlation rose to + .89. As is usual in such ratings, increasing the number of judges gives greater stability to the average result. In this case "quality of teaching" was supposed to be judged. All we know from the correlations is that *something* was done with reasonable consistency by the class as a whole; whether or not this something bears any actual relation to "quality of teaching" is, of course, not revealed.

In a later experiment with more advanced students, itemized rating scales as well as rankings were used, and 16 of the teachers were also rated by five colleagues of equal academic status. Between pairs of ratings the correlation was but + .30 in both cases. This means that teachers disagree in judging one another as widely as do students in judging teachers. If this is true, even on the mature level of college students and teachers, the lack of definite results from similar studies on lower educational levels is not surprising.

From a study of preferences of seniors and freshmen, Guthrie was led to the opinion that "seriousness, clarity, definiteness and authority were more valued by the freshmen, and that originality, wide information and humor were more appreciated by seniors."

The net outcome of studies of the qualities of teachers would appear to emphasize diversity rather than standard pattern. Perhaps because students themselves are so varied in interest, character and quality, equally effective teachers may succeed by a variety of qualifications. Inquiry concerning the desirable qualifications of teachers would appear to be like questions as to the value and desirability of foods, tools, clothes and medicines. There is a great diversity of each, and each may be in its own place excellent.

Professional specifications for teachers, in general, are in much the same state as is vocational guidance for the pupil. No cut and dried techniques are available, and experimental outcomes are full of uncertainty. Nevertheless, reflective consideration of the problem and efforts at analysis may serve to direct attention usefully and profitably, and the mere consciousness of the question may result in good to all concerned.

PROBLEMS

1. Secure statistics showing the number of pupils in the public schools of your own community and their distribution on the various levels. How do they compare with those cited in the text?
2. If test scores are available, compare the range of mental age or of I.Q. of pupils in an elementary grade with those in a high-school year. How do you explain the results?
3. Find figures showing the illiteracy of different states of the Union and consider what explanations are to be given for the differences.
4. Rank your own previous teachers in an order of merit for estimated teaching ability, and try to list the respects in which those ranking high differ from those ranking low. Compare your results with those of other students.
5. Secure a copy of the Schutte (or some other) rating scale for teachers and grade yourself on it. Have some one else also grade you on such a scale and compare the two ratings. What useful suggestions come from such an experiment?
6. A useful experiment is to have all members of the class grade

the same teacher on such a rating scale, and to study the closeness of agreement on various traits. What suggestions come from such an experiment?

7. Give the "Aptitude Test" for teachers to all members of the class, and compile, compare and interpret the scores.

8. Prepare a list of "qualities" which you think belong to good teachers. Then rank these qualities in their order of relative importance (*a*) for elementary school teachers, (*b*) for high-school teachers, (*c*) for college teachers. What, if any, are the outstanding differences in these rank-orders, and why?

9. Think of the teacher who seems to you to have been most influential in your own school career. Write a character sketch of this person, in the endeavor to portray the precise reasons for the exceptional influence.

10. In what ways have your conceptions of a "good teacher" changed as you have grown older? Why?

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CHAPTER XXII

THE PSYCHOLOGY OF EDUCATIONAL CHANGE

The instability of education. One might expect that since education is such an old and established enterprise, it would long ago have settled into stable form and uncontroversial pattern. Carpentry, agriculture, cooking and religion, as human activities, have done this, and they now change very little from generation to generation. But education is far from stable; it is full of controversy and always being modified. If you learned to teach "elocution" twenty years ago, you will find little place for your skill in modern schools. If you learned your physics, your chemistry, your geography then, you have had to do much un-learning since, or else your head is full of a lot of nonsense. Education is full of innovation; it is unstable and characterized by constant variation. What are the reasons for the fickle character of education?

There are, to be sure, no startling new discoveries to be announced in this connection; the reasons are fully patent and perhaps well known. They are at least readily recognized when pointed out; but they are seldom assembled and explicitly formulated. It may be useful to survey them, if only for the sake of knowing consciously what the motives are that actuate some of our educational behavior. The influences making for change in this field are chiefly psychological. Education does not change because of changes in the physical character of man's world. Nor does it change because of biological modifications in his organism. The instability is chiefly due to changes in human interests, knowledge, beliefs, ideals and attitudes. These are psychological facts.

Complexity as a cause of change. In the first place, we might expect education to be unstable because of its sheer complexity. Education is not a simple process; it is, instead, very complex, and on the whole the more complex the activity the greater the likelihood of instability. The simple diagram which we have called the educational pyramid (see Chapter XXIII) serves to call attention to this complexity, and also to indicate the chief points where we may look for change. Once the pyramid is drawn it looks solid and crystallized. But only its general pattern is immutable. The details and components are in constant flux, so that the pyramid is really an animated structure. It will be useful, in referring to the nature and causes of educational change, to seek sometimes to locate these changes in the educational pyramid.

1. **The lack of scientific foundations.** The first reason we may cite is that education has never yet been based on an adequate scientific foundation. In objective and in subject matter it has followed the whim of authority or the temperament of popular philosophers. In technique it has followed the dogma of inspiring and often of aged masters, the private hunch and intuition of the teacher, some cut and dried conception of the nature of the mind, or proceeded wholly by the method of trial and error. Education has tended to be more like clothing than like agriculture—more closely related to ornament and display than to utility. It has, therefore, been changeable. Fashions and styles *demand* change; without it they languish, and there is no style.

2. **The introduction of scientific inquiry.** Curiously enough, we may cite as the second reason for educational change its very effort to place itself on a scientific foundation. The introduction of the methods of science into the field of education itself, the development of experimental education, the demand that educational principles and methods be given substantial, objective and demonstrable support, have made not for stability but only for further changes.

Increasing knowledge makes better adjustment possible. Think of the invention of intelligence tests and the way their application has affected the learner. He has been classified, selected, his scholastic aptitude discovered beforehand. His placement and guidance, and the methods used in his training, have been definitely changed and adapted in the light of scientific advance in education itself.

Think of the experimental failure to find any large degree of formal discipline or transfer in many of the fields of study, and of the way this has reacted, this time chiefly upon the curriculum and the methods of instruction, but also in important ways upon the very character of the educational objective. Abandoning the notion of the extreme importance of transfer has meant a shift from formal exercise of the mental powers to the effort to select specific items and skills which have particular relevance to the work of living.

Think of the development of educational product scales, of objective examinations, and of the way these have inevitably modified the methods of instruction, the criteria of progress, and even demonstrated the relative unimportance, for school training, of many elements of the curriculum formerly given large attention. Even the teaching personnel has been modified in the light of such results, for teachers must now be capable at least of understanding the vocabulary of scientific education, instead of merely being pleasant people, sustaining friendly relations to the members of the school board responsible for their appointments. Every corner of the educational pyramid has thus been changed by the introduction of scientific and experimental methods into the field of education itself. In the transition this instability has not counteracted, but has only added to that resulting from the considerations discussed under our first heading.

3. **The instability of democracy.** In the third place, education in a democracy means democratic education. Democratic institutions are subject to popular wish, popular fancy and demand. No authority in a democracy can fix an institution for so long as a generation, and education in a democracy changes just as do our political administrations, our platforms, our tax rates and the amendments to our constitution.

Inasmuch as a democratic institution is not some fixed thing provided freely for every person but, instead, for each person that which he wants so far as it is reasonably consonant with the wishes of others, we have in education, as in all our institutions, instability, local option, experiment, and therefore variety and constant change.

4. The reflection of world change. A fourth reason is the fact that progress of invention, discovery, and industrial revolution constantly adds new materials to human accomplishment. Hence there are constantly new details to be mastered. Changing forms of training and preparation are demanded to keep up with social and industrial development and the differentiation of labor. Such influences have also more and more taken education out of the home, along with baking and weaving. The schools have, therefore, been required to add to their tasks many of those features of training formerly acquired by apprenticeship methods at home, on the farm and in the shop.

The result has been new kinds of teachers required, new curricular material, modifications of educational objective, variation of the most profound sort in incidental or extracurricular activity, new kinds of learners, including now adults and preschool children, and consequently adaptations of technique and methods of instruction. Again, all the poles of the educational pyramid are subject to change, and all the lines connecting them.

5. Lapse of time as an influence. Closely related to this fourth influence is the fifth, which we may call the mere lapse of time. As the years go by the very facts of history, geography, literature, language, change. Errors are corrected, and new events now call for inclusion in the textbooks, and for record on the maps. Civilization is cumulative and constantly produces new material, some of which must be added to the curriculum of the school and become part of the equipment of every well-informed person. We need only cite the far-reaching influence of the World War in modifying the facts of geography, the maps of the world, the character of the world's literature, its history, and even to a considerable extent the subject matter of psychology.

6. The prolongation of infancy. A sixth factor is that the increasing complexity of civilization demands an increasingly intensive, prolonged and complete preparation to sustain its activities. The period of infancy once terminated at adolescence; it is now prolonged into middle age. The tasks to be accomplished by adults require a longer period of selection, a broader accumulation of knowledge, a more extensive experience before responsibility can be assumed and social independence achieved.

Within our own memory boys became medical men by what was called "studying with the doctor." They cared for his horse, cleaned his office, attended him on his calls, arranged his instruments, read such of his books as they could understand, and then with few preliminaries began to practice upon the natives. All nurses were then "practical nurses"—chiefly widows and single ladies of benevolent disposition who were willing and apt in caring for the rough details during one's illness, and preparing him for decent burial at its termination. Teachers were then only people who had "finished school" and were willing to "do a bit of teaching" before settling into some more dignified occupation. All these things have changed. We no longer trust ourselves to the practical nurse, the self-made doctor, the impromptu teacher. They must be trained with diligence and duly certified; their period of infancy is thus prolonged. For all-round utility men we substitute the highly trained specialist. But special training means more highly differentiated education, and the schools must change to keep pace with these demands. Little wonder that education is unstable and constantly being modified. But we are not yet more than half way through our list of influences.

7. The spirit of the age. As a seventh influence we may cite the general "spirit of the time," which is all against tradition. This spirit shows itself in many other fields also—in art, in literature, in politics, in law, in dress, and in social conventions. The revolt of the young against the established forms of antiquity will always go on, and during the past century this spirit has been especially prominent.

The century has been forward-looking, rather than backward-looking, as some centuries have been. Only in a backward-looking civilization, such as that of the old China, can education become stabilized, and there it did so with a vengeance. The greatest crime of our day is to be a back number. This spirit also affects education. Even if the fundamentals remain unchanged, superficial fads and frills must come and go, and be featured in school advertising, thus giving at least a strong impression of change. Even though the old complain that the more we change the more we remain the same, the *appearance* of change must be fostered because the spirit of the time requires it.

8. The emphasis of the individual. An eighth influence making for change is to be found in the modern emphasis on the human being, the individual, and his rights. This emphasis has been conspicuous in many fields. In legal affairs and criminology the individual has been accorded a place he never occupied before. Responsibility tends to be less and less an all-or-none affair, but is approached more and more in the light of the individual, his make-up, his history, his provocation. The penalty tends more and more to fit the criminal, rather than the crime. In industry and management a similar influence has been at work. Not the gang but the individual worker is more and more being considered the unit of operation. Only in the army is the squad or company still the unit of consideration.

In education this same tendency leads to a lessened worship of subject matter and to greater concern with individual need, individual interest, individual rate of progress. All this makes for variation and instability, since the most significant thing about individuals comes to be their differences. Flexibility of procedure and requirement increases, and demands are less rigid and uniform. Elective systems come into vogue, and individual guidance. Such a decline in the militaristic spirit, such an emphasis on individual initiative, makes for change and variation. This influence has in recent years been somewhat held in check by the enormous increases in student enrollment in all kinds of schools, and variability as dependent on individuality comes to be more an ideal than an executed accomplishment.

But the facts of individual difference have now been deeply impressed upon our educators. It is realized that although people are much alike in their fundamental needs and in their strivings, cravings and wishes, they differ notably from one another in their native capacity for accomplishing these desires. Developing techniques for the identification and measurement of human diversities lead constantly to new adaptations to these differences. Differentiation in school program, in technique and objective, will increase rather than diminish.

Intellectual differences, such as those between the normal, the gifted and the deficient, have already led to changes in method, rate of progress, and subject matter. Discovery of special talents will lead to still further differentiation. As rapidly as means develop for the analysis of character differences, we may expect still further modifications in education.

The slogan of the Rotary Clubs may still be "A high-school education for every child." But either the slogan must be changed, which will result in modified educational aims, or else the nature of the high school must be modified, which will be an equal change. One thing is sure—that change we must.

9. The dynamic psychology. The abandonment of the old passive, or quietistic, notion of the nature of mind, the *tabula rasa* picture as drawn by the associationists, must be cited as another influence, of a somewhat philosophical kind, making for educational diversity. The gradual development of what is sometimes called the *dynamic psychology* makes for a modified conception of the nature of learning. Instead of the ideal of pouring ideas, impressions, and information into an empty mind, there comes the necessity of evoking active enterprise in an individual who is already an active creature. This has meant loss of uniformity in subject matter and method, in favor of a striving for spontaneity.

To learn by doing, rather than to learn by listening, implies variation, for we vary more in our executive apparatus than we do in our sensory equipment. Conceive, for example, the difference in the teaching of composition when, instead of *reading* famous essays, the class proceeds to learn by *writing themes.* The more rapidly this notion of "dynamic method" has developed, the more variegated have become our subject matter, our technique, and our standards of accomplishment.

10. Changing cultural ideals. Another factor making for variety in education is the changing cultural ideal. In the course of any period of time we see that in society as a whole the dominant ideals change. Thus in our own national and educational development the following shifts may be clearly discerned:

Early education, in the colonies, was largely for the purposes of *piety,* particularly in the case of higher education, which was originally conceived for the training of preachers. Puritan training was chiefly for the virtuous and godly life, and in some institutions this motive is still dominant in elementary education.

Next, with the establishment of democratic nationality came the ideal of intelligent *civic and political activity.* Education was then in large part to prepare the citizen to vote with intelligence, to administer his borough with wisdom. Since women had at that time no part in these affairs, their education was correspondingly limited.

More recently the *social ideal* has supplanted the political one. Civic activities came more and more to be matters for experts, and the common man's life is instead a social and economic one. Education then comes to be for socialization, for the establishment of cordial and sympathetic coöperative habits of life and thought.

We see during war the way in which education is at once bent toward developing military efficiency. We might safely predict a still later change in which, with increasing leisure, prosperity and peace, education might be made to minister toward the esthetic claim instead.

Education thus varies in response to the changing ideals of the time. Perhaps it also has something to do with shaping these ideals; certainly it is responsible in part for perpetuating them. The relationship thus becomes complicated. It is clear, however, that education is not solely responsible for the ideals of the times, and that some of its changes are in response to changes in these ideals, initiated in other ways.

11. The loss of frontier life. Another factor to which may be attributed many changes in modern education in America is the loss of frontier life. Under primitive and frontier conditions of living, much education for actual life was a matter of incidental activity. Children faced life, with the parents, at surprisingly early ages as compared with children and parents of to-day. The young acquired knowledge of materials, and skill in methods. They were confronted with ideals such as those of thrift, workmanship, coöperativeness, self-reliance, courage, and the like, not in the mock situations of the modern school, but in the daily routine of living. Perhaps the manual and physical activities of such a life built up, in those who could survive them, still more vigorous bodies. Even the diversions, the recreations, and the sports that were available called constantly for skill, courage, quickness and friendliness.

The child born and reared in the modern city apartment loses this incidental contact with the fundamentals of life. He has plenty of contacts, to be sure, but they are with things far from their sources, with artificial products. He does not see where his bread and milk come from and sometimes has very fantastic notions about such matters.

His activities are cramped, directed, supervised, and seldom in direct contact with the soil. For these various deprivations, as they have developed, the school has sought constantly to compensate. It is remarkable how many of the "innovations" of modern and "progressive" schools consist in attempts to provide substitutes for the incidental features of frontier existence. They take the form of groping after concrete, manual, social, vital experience which can in some way be introduced into the urbanized life of the child. Projects, camps, work units, part-time-work schemes, individual instruction, vocational experience, trips to the country, Dalton plans, purposive problems, gymnastics, and many other modern devices fall into this category.

There is reason to expect that in time education, so far as conducted by the schools, may come to consist mainly in the provision of these artificial substitutes for primitive living on the part of children. Culture may come once more to mean knowledge of the old ways, acquaintance with the activities of those who have gone before. Verbal training, esthetic education, liberalizing information, scientific knowledge, may then be acquired incidentally, and the former incidentals take their place as the formalized curriculum of the school.

12. Shifting character of the school population. The twelfth and last influence to which we may now call attention as responsible for educational instability is the rapid increase and the shifting character of the school population. During the past twenty years, for example, the proportion of children entering the elementary schools has changed but little. But the proportion entering high school has increased tenfold, and the proportion entering college has increased fivefold. There is evidence that this increase means also a lower general or average capacity, since in earlier days there was a tendency for education to select the more able.

This entails a great readjustment. New types of high-school training, new standards of college work, the formation of special groups, such as the Honors groups, the transformation of high schools of the old type into commercial and vocational high schools, prevocational schools, junior high schools and junior colleges. Even graduate instruction has had to face a lowering of standards. Higher education has rapidly assumed a vocational or professional rather than a cultural or scholarly aspect. The universities attract many not capable of nor interested in the research life for which earlier graduate instruction was a preparation.

The changing character of the school population, in one direction or another, is likely always to continue. As the school population changes, education must of necessity change, in its subject matter, its methods, its organization, its objectives, its personnel. Changes in the character and purpose, that is to say, the ability and interest of the learner, change all the other poles of the educational pyramid.

Summary of the causes of instability. Briefly then, the chief influences making for educational instability, to which we have called attention, are the following:

1. The lack of adequate scientific foundation
2. The application of scientific methods to education itself
3. The characteristics of democratic institutions
4. The progress of invention, discovery and knowledge
5. The mere lapse of time, with its consequent changes
6. The increasing complexity of civilization and the prolongation of infancy in the human species
7. The variable spirit of the time—the demand for change
8. The modern emphasis on the individual and on individual differences
9. The rise of the dynamic psychology
10. The prevailing cultural ideals
11. The loss of frontier life, and the effort to compensate for this loss by artificial substitutes
12. The shifting character of the school population

Prospects for future stability. That there are other influences making for educational change we need not doubt. To have some of them clearly in mind may assist us in understanding the motives for our behavior, and in controlling more adequately the direction of the change, toward more complete adaptation and usefulness. The question may be asked—"Will education always continue to change?" To answer this question we need only summarize those influences which we have just considered in the single statement that education changes because it is alive. When it ceases to change, it will be dead.

There is indeed every reason to suppose that as time goes on education will change more rapidly than ever. Readier communication and more sensitive social machinery will put it increasingly in touch with changes in social psychology. Transformations in society and in industry that would once have required a century now occur in a few months. As civilization increases in complexity, its pace quickens. So long as education is an integral part of social life, and it can scarcely cease to be this, it will inevitably take part in this animation. The more clearly conscious we are of the reasons for its instability, the more surely, we may hope, will we be able to transform mere vivacity into progress.

A live education will, moreover, not only react to changes in the world about it; it will itself become an active instigator of change. Failure to do this results in a baggage of encumbrance, a load of vestigial organs, which are as dangerous to education as they are to an organism. Positive participation in the changing world is required to save education from falling prey to a neurosis. What would an educational neurosis be?

Educational neuroses. What is called a "habit neurosis" easily develops in predisposed individuals. An act or attitude that once served to relieve an acute distress persists long after that distress has disappeared. It is now touched off by reduced cues, slight features in which new situations resemble the old one. A lack of adequate sagacity is the predisposing factor in such an individual.

Social institutions easily show similar vestigial features. The gargoyles and false fireplaces of architecture; the useless sleeve buttons on men's coats; lingering magical ceremonies; the institution of right-handedness; the perpetuation of the imperfect typewriter keyboard will serve as examples.

Educational practices that are not sensitive to current needs and motives may persist as hang-overs when the distress to which they once ministered has long ceased to exist. Such archaic features are sometimes "vitalized" by attributing to them new motives or adapting them to current needs as well as they permit. Often they are perpetuated on the basis of mere precedent; they serve only as monuments to historic adjustments. But such vestigial features resemble the habit neuroses of the individual.

Motivation is a useful concept in education; but the effective motives should be live, not dead ones; they should be current, not historic. An aim of modern education should be not merely to be the bewildered victim of changes in the world about it, but actively to initiate change, both in itself and in that world.

Advocates of motivation have often had in mind only a traditional subject matter or set of activities which they then sought to keep alive by searching for motives to which they might feasibly be attached. Such a procedure encourages educational neurosis—the perpetuation of a practice the initial motive of which has already been relieved.

A useful goal is that of beginning with current motives rather than with established practices. The practices may then be shaped in terms of the contemporary distresses which it is the function of education to relieve. But such a plan involves a constant and continuous inventory of current needs, a ready institutional flexibility, a wise insight into the suitability of curricula and techniques.

The actual difficulties in the way of such a program have been illustrated by the reluctance with which oral spelling and reading, futile problems in arithmetic, and the awkward typewriter keyboard are abandoned. The student of education can easily point to numerous features of any school situation or program, the persistence of which merits the term habit-neurosis. The realization that there is after all an inherent instability in education, and a discernment of some of the influences back of this instability, may enable educators to take a more active part in determining the nature and the course of those changes. In this way education may escape becoming a museum of historic practices, and become instead a lively instrument of contemporary adjustment.

The situation is complicated by the fact that education aspires to be not only ameliorative, but preventive as well. Its aim is not merely to relieve distresses when they arise, but so far as possible to prevent those distresses. Education is often, therefore, impelled to a certain indirectness. Its objective is to prevent distress, but its technique calls for the adaptation of procedures to actual motives. It is, therefore, often the case, especially on the lower levels and in work with younger pupils, that the motives actually available in the process of teaching are not those in the ultimate interest of which the teaching is undertaken. The solution of this difficulty is to be found only in a more precise and complete analysis of the educational situation, and a conscious distinction between the expediencies of instruction and the foundations of the ultimate objective. But the more closely the two can in fact be identified the better integrated will teaching be with the life activities of the whole person.

PROBLEMS

In the light of your study of educational psychology, what may be said on the following questions, under the general topic—"What does education do?"

1. Does education change man's original nature? Does it change the individual's nature; does it change the nature of succeeding generations?
2. Does education equalize abilities? If not, in just what way does it affect the diversities of mankind?
3. Does education promote growth? Does an organ or function that is trained or exercised thereafter mature more rapidly or to a more advanced point than would have been the case without the training?
4. Does education select the able? If so, in what ways do the

schools act as selective agencies in human society? Should they do this? Is it commonly supposed that they do?

5. Does education promote adaptability? Or is the effect of education to crystallize and fix certain types and attitudes? If you cannot generalize, why not?

6. Does education increase vocational competence? Does the salary of the better educated exceed that of the less educated because of the education received? What complications enter into the problem?

7. Does education make for originality and for increased initiative, for a quickened imagination and a readier versatility? If not, why not? To what extent does originality depend on familiarity with what has already been done in a given field?

8. Does education promote social adjustment, or does it instead only intensify the frictions that already exist? What qualifications should you wish to make to your decision?

9. Does education increase the scope of the individual, enlarge his sagacity, or does it tend to fix him in an established and prestigeful routine?

10. Does education increase human happiness, or does it, by lowering the threshold, only serve to increase the burden of human misery?

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CHAPTER XXIII

THE PLACE OF PSYCHOLOGY IN EDUCATION

Major aspects of education. In concluding this introductory survey of educational psychology profit may be derived from a brief account of the field of education as a whole. Education requires more than psychology as its basis, and it may be well to consider what part this science plays in the total enterprise. Education, moreover, presents many psychological problems which this survey has not introduced, and an indication of the nature of some of these problems may serve to suggest further excursions into the field of educational psychology.

In the introductory chapter attention was called to the related fields of educational philosophy, the history of education, and educational administration. These, along with educational psychology, are commonly recognized as constituting some of the main divisions of the general subject. A few words concerning these fields will suffice to indicate their general relations to educational psychology. We will then be ready to suggest a rather formal diagram on the basis of which a great variety of psychological problems may be organized.

The philosophy of education. First of all, the education of any creature, whether man or lower animal, involves a certain philosophy. *Why* should the creature be educated? Why not leave it to its own devices, subject at least only to that education provided by chance and accident, and based on ignorance? *To what end* do we educate? What is the *objective* of education, either in general or in the case of the particular individual and the special occasion? As we might expect, various philosophies of education claim attention. By way of example a few of these may be briefly indicated, without any attempt to assess their merits.

(*a*) A *protective* philosophy might maintain that the objective of training should be that of making ourselves more comfortable and safe. In some such way we train dogs, for example, not to bite, not to chew furniture, and to conform to special standards of cleanliness.

(*b*) A *sentimental* philosophy might instead stress the individual, rather than the social group. Each creature, it might be maintained, has certain potentialities and should be enabled, through training, to express to the utmost whatever impulses it finds itself possessed of.

(*c*) A *vocational* philosophy might emphasize a very different objective. Each creature, it might contend, should be prepared, through education, to achieve a maximum career, to play an effective and prosperous rôle in the work of the world, and to supply itself and its dependents with the best possible supply of creature comforts.

(*d*) A *religious* philosophy might, on the other hand, minimize the vocational motive as relating too closely to this world; education might instead be conceived as a means of preparing the individual for the life to come.

(*e*) A *social* philosophy might assert, instead, that in the great society of creatures of his kind the individual should by education be best prepared to fit into the whole and to take a share in the building of that society, with little regard to his material or personal prospects, or to the life to come.

(*f*) A philosophy of *selection* might regard education merely as an effective method of discovering and identifying able individuals—a series of tests to measure the individual's zeal or level of ability.

Obviously there are any number of educational philosophies, and any number of modifications or combinations of them. While it seems apparent that education, to be effective, must proceed always in terms of some more or less explicit objective, the choice and formulation of this objective is likely to be made in terms of contemporary values, aspirations and opinions. While psychology may make its contribution toward the selection, shaping and determination of these values, we must recognize that the *philosophy* of education is in itself an activity and a responsibility of great scope and of infinite detail.

The history of education. The education of any creature, since this is in the long run an experimental venture, cannot afford to lose sight of history—that is, the history of education. It would obviously be foolish for one generation of educators to refuse to profit from the experience of past generations in confronting the problems of teaching.

Throughout the ages, in every land, experiments in education have been made. Here this method and there that method has been advocated, tried out, adopted or abandoned. An inventor or an explorer who should shut his eyes to the records of those who have gone before him would waste his own energies and imperil his own ventures.

In the same way modern education is much concerned with the education of past epochs—its objectives, its methods, its successes and failures. The history of education is, therefore, an important field, which constantly overlaps but cannot be identified with educational psychology.

Educational administration. Educational efforts that are deliberate and organized soon of necessity become institutional. They come to involve a complicated machinery, and this machinery calls for care and maintenance. Means must be secured to provide such machinery; taxes raised, bonds issued, teachers engaged, substitutes arranged for, records kept, buildings erected and maintained. Even the training of a lower animal, such as a pigeon, a dog or a white rat is found to involve such complicated machinery that *administration* becomes itself an important aspect of the whole process.

In human education, of course, administration extends far beyond the provision and care of the physical plant, the schoolhouse, grounds and books. Financial obligations, personnel relations, selection, promotion, examination, certification, the enlisting of community support, the promotion of legislation, the control of publicity, are only a few of the burdens put upon the administrator.

Naturally enough these various fields of education cannot be kept entirely separate; and there are still other fields, such as educational sociology, educational statistics, educational research. Administration must be in terms of objectives; objectives will be chosen in the light of history; and administration and philosophy will themselves have a history. The projects of educational psychology also must be in constant contact or interrelation with the major fields we have already indicated.

The scope of educational psychology. A schematic indication of the range of educational problems in which psychological questions may arise may serve several ends. It may show for one thing how educational psychology pervades the whole field; it may suggest some of the many points of contact with other major aspects of education; it may serve as a partial review of topics treated in the foregoing chapters and perhaps impose a certain order and arrangement upon topics that may seem to have been treated independently and in isolation; it may also suggest a useful way of thinking about new educational problems and of analyzing them from the vantage point of other topics. However mechanical and formal, this scheme will serve as a convenient map for the orientation of educational thinking.

We may begin with the learner and represent him by a small circle. This does not mean that he is a mere zero, nor that he is wholly empty. If a college freshman, for example, he brings much with him when he enters the college classroom for the first time. There should be room for improvement, but the learner, even if only a puppy or a kindergarten infant, always has some *content.* If he did not, we should despair of doing anything educational with him. For pupils can be taught, as we have seen, only that which they are already capable of doing. Learning consists in coming to do, upon slight cues, acts which could already be achieved, but only on the basis of elaborate and complex antecedents or stimuli. Primary experience is a prerequisite for further education or training.

One of the first educational problems, in any actual situation, is that of ascertaining what the learner already possesses —securing an inventory of his present status and achievement. Let us then indicate the presence of *initial content*, of as yet undetermined character, by placing a question mark within the circle. The question mark will mainly emphasize the fact that the learner is not "a fresh sheet of paper" on which the school may write. Indeed, much of education, whether elementary or advanced, may consist in *erasing* content which the learner brings.

In our diagram we place this circle, the symbol of the learner, low down in space. "Below" and "above," although only convenient spatial relations, serve to provide a symbolism for more complex meanings. Placing the learner low implies that education is to *elevate* him. Training children has long been known as *raising* them or *bringing them up.* Through education the learner is to be put on a higher plane.

We may, therefore, represent the pupil, when *educated,* by a circle higher up in the field; he is also a larger circle, if only because of growth. It is possible that education may have something to do with directing the natural *expansion* or *enlargement* that comes chiefly as the result of maturation. How much it has to do with this is one of the fundamental educational problems. This higher position is in one sense the *objective* of education; it is the *goal* of the learner; the point at which he wishes to arrive. Thus arriving, not only is his position changed, but he is himself also different. What is now his content? What has education *done* to him? Let us again represent this content by a question mark, this time by a larger or a double one.

This problem of what the learner is then to be like, when "educated," is said to concern the objective of education. How is he to differ from his initial self? How is he to differ from the matured but uneducated person? What is an educated person? How much of this change is due to the school, as an educational agency, and how much to learning incidentally achieved?

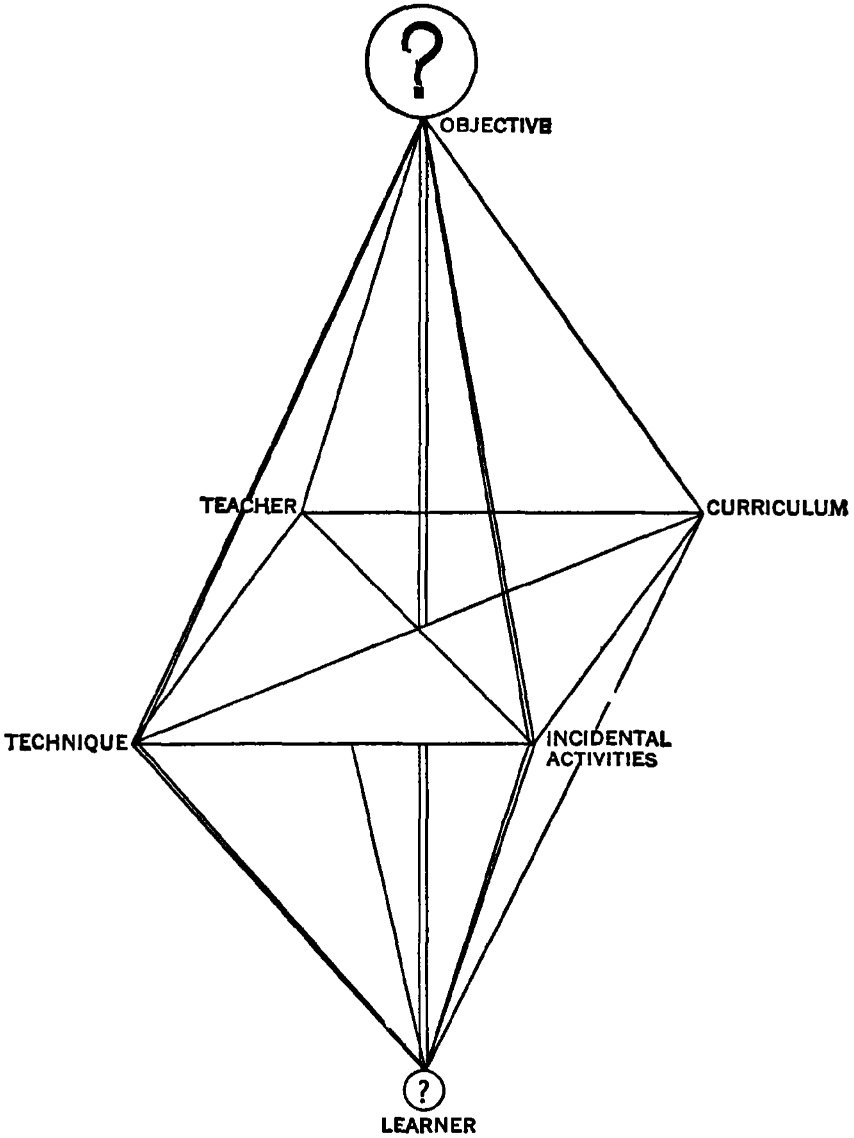

FIG. 50.—THE EDUCATIONAL PYRAMID.

Now in advancing from the initial low plane to this higher level, and in expanding from the small zero to the larger and fuller circle, the pupil has *gone through* the educational agencies. What are they? What precisely has been brought to bear upon him? These agencies reduce ultimately to four cardinal features—the curriculum, the teacher, the technique, and incidental activities. These are the four cardinal poles, along with the two poles provided by the initial and the final status of the learner. Let us represent them by points, distributed symmetrically about the vertical axis representing the path of the learner.

But we must not leave them thus disconnected, implying that they are merely obstacles or hurdles which the learner must *get by*. All these, along with the career of the learner, comprise an organized enterprise, an organic system. Each pole sustains relations to every other pole. We can best represent these relations in our diagram by drawing lines connecting these poles, giving us a double pyramid, which we shall use as our diagram of the educational situation, as psychologically considered.

Psychological problems or topics arise in connection with every point or feature of our diagram, considered in and for itself. Other problems arise which are concerned with all the possible relationships. Thus we see what a complex and organic thing education is. Each feature varies with every other. Who shall teach depends on what is to be taught. What is to be taught depends on who is to learn. And so on.

To master the psychological aspects of all these educational features and relationships is a large task. Our own account has of necessity been limited to a discussion of representative topics chosen from this elaborate field of inquiry. But it will serve a useful purpose to indicate briefly in connection with some of these points the nature of some of the many psychological problems that arise, without any attempt to give at this time the solutions or suggested solutions of those problems.

Representative psychological issues. 1. *The learner.* We have already emphasized the necessity of considering what the learner brings to his task; what his original or present equipment is; what limitations, motives, special talents and defects are to be encountered. Other problems relating to the learner are those concerning his heredity; concerning the laws of learning that may be expected to operate in his case; concerning his level of intelligence; his mental health; his emotional balance; his prospects and probable future; his developmental status; his array of interests; his prejudices; his home environment; his past record in school; his character traits, and the probable basis of their acquisition; his physique and bodily condition.

In the nursery school much attention is given to all these and many other details of personality. The services of nurse, pediatrician, physician, dietitian, clinical psychologist, play director may all be taken advantage of. In the elementary and secondary school years, under compulsory education laws, somewhat less official attention may be given to these points; but in higher and professional training there is likely again to be a directed effort to study the individual pupil and to select more or less intelligently those students deemed most likely to be able to derive the greatest advantage from the educational provisions that are offered. At least, the ideal would be for all education to be guided by all that can be known about the characteristics of the individual pupil.

2. *The objective.* Without explicit recognition of the objective, is education likely to be blind, mechanical or futile? Consider how different the education of the college student would be, if planned in the light of one or other of the following conscious objectives:

(*a*) Cultural polish
(*b*) Development of originality
(*c*) Shaping of character
(*d*) Acquisition of social graces and friendships
(*e*) Vocational training
(*f*) Disciplining the mind

(g) Making of competent graduate students and research workers
(h) Satisfaction of intellectual curiosity
(i) Development of effective citizenship

Is it not clear that even this far along in the academic route we require an adequate psychology of objective in order to shape the motives and incentives, choose the teachers, adapt materials and curriculum, select students for admission? In what is called reëducation, as in the training of cripples, the objective is usually specific and definite, and consciously considered both by pupil and by the educational agency. In elementary and secondary education it seems reasonable to suppose that control by awareness of clearly formulated objectives should be equally important.

Other questions are such as these. How should educational objectives be determined? Do learners behave differently with objectives determined in different ways? Should the pupils themselves determine the objective? Or the parents? Or the school board? Or the legislature? Or the clergy? Or experiment? Or tradition? How can the adequacy and the feasibility of objectives be determined? Are objectives permanent, or if not, how do they vary with age, time, social conditions, politics, science, and other variables?

3. *The curriculum.* The universe is available; what shall be taught; what omitted; what left to individual discovery or to accident? It might be *best* if all knowledge could be acquired and all skills mastered. But there are limitations. What are they? What principles of selection are to be applied? What knowledge is of most worth? How are various items in a possible curriculum related to the objective?

Having selected a curriculum in the rough, there still remains the problem of its organization. If spelling and writing are to be taught, should they be taught together, or one before the other, and at what age, and in connection with what other activities, if any? If geography is to be learned, just what geography? And in what order? And to what degree of perfection in the various cases? Is it more important, educationally, to know the products of Brazil, or to be able to bound Bulgaria, or to be able to draw a map of the school grounds? Or should any of these be included in the curriculum, and if so, in what curriculum if not in all?

Consider the required program of a certain liberal arts college. Each student was required to pursue three hours (semester) in psychology, six hours in history, twelve hours in the classics, and twenty-four hours in some major subject. On just what grounds is classics accorded twice as much emphasis as history? And why twenty-four hours in a major subject rather than forty-nine hours, or why a major subject at all?

Every educational enterprise adopts a curriculum, that is, a set of activities in which the learner engages. The determination of such a curriculum *ought to be* established on adequate psychological grounds, and perhaps this serves to indicate the nature and importance of the topic as a whole.

4. *The teacher.* What are the qualifications of teachers, if any, as distinguished from those engaged in other activities? Should teachers of singing be able vocalists? Should teachers of composition be clever writers? Should only poets teach poetry? How shall teachers be selected; how promoted; how compensated; how shall their effectiveness be compared? How can teachers best be motivated; how can they best be prepared; is there a "teaching instinct," or is teaching an art like playing the violin?

Should teachers of boys be men only? Should colleges for men include women on their teaching staff? Does it make any difference, to the pupils, to the teachers, to the community? Are intelligent teachers best for kindergarten, or is high intelligence a handicap in such work? Should college teachers be given advancement on the basis of (a) their scholarly publications, or (b) their classroom success, or (c) their service on committees?

Should married women be allowed to teach in the schools? Should teachers be the judge of their own methods; or should they be rated by others? If rated, by whom? By their pupils, by other teachers, by parents, by occasional inspectors? What traits do elementary pupils, secondary pupils, college students, professional students, most admire in their teachers? Does this have anything to do with the effectiveness of teaching?

There are at least plenty of questions to be raised concerning the psychology of the teacher. We have merely suggested a few, and the list can easily be supplemented and improved by any one with educational interests or experience, whether as teacher, pupil, administrator or patron.

5. *The technique.* Problems of method arise at every point in an educational activity. How shall we ventilate the schoolroom? How shall we motivate the pupils? How shall we grade the papers? How shall we test the effectiveness of teaching? What method shall be used in teaching reading? Which method of teaching penmanship is the most effective? Shall typing be taught by the touch method? Shall the playing of scales in music precede the learning of very simple melodies? What are the disadvantages of drill? Is the project method effective?

A concrete instance may be found in the teaching of educational psychology. How shall the teaching be conducted, how shall the learning proceed? What experience shall constitute the learning? Shall we use lecture or discussion method? Shall examinations be essay or true-false in type? Shall there be apprenticeship? Shall visits be made to schools? Shall men and women study together? How large a class is most favorable? What topics shall be included, and in what order? Are some topics better presented in lectures, others in demonstration, others in discussion? Shall laboratory exercises be attempted? And so on. Presumably some methods of teaching educational psychology to college students are more effective than others. The problem of technique then is no less vital than in the case of arithmetic, spelling or geography.

Technique is, of course, so closely related to special circumstances, subject matter, and personnel, that special study in each field of instruction will deal with methods suitable thereto. But it is important to realize that for the most part all these questions of technique are fundamentally problems of psychology.

6. *Incidental activities.* No matter what educators do about it, people will live, observe, play, fight, learn and forget, wholly aside from the activities of deliberate instruction. The young child spends but a small part of his time under the eye of the pedagogue; at home, on the playground, during the vacation, with friends, family and among strangers, he still lives an eventful life. The high-school or college student develops elaborate extra-curricular activities, social events, athletics, glee clubs, newspapers, in addition to his life as an ordinary citizen and his time in the classroom.

It is a fair question, and an important one, whether the influence of these incidental activities is not as great as that of deliberate instruction. A more pertinent question is whether or to what extent such incidental activities may be tied up more closely with the ordinary aims of education, and perhaps in some ways substituted for the formal activities set by traditional school practice.

In frontier conditions the experiences of "actual life," as distinguished from "school life" made very important contributions to the education of the young. There, experiences were provided in a wholly incidental manner which must now be secured only at the expense of deliberate planning and special machinery. Especially perhaps in connection with the learning of work habits, the development of character traits, and the education of the emotions, it is at least possible that the incidental activities of the learner exert important influences upon him, and that deliberate educational plans should be intimately tied up with these activities.

Various relationships. The various relationships which arise between these main poles of the educational pyramid afford some fifteen main lines along which special psychological problems may arise. A few of these may be here noted, with brief sample questions. The remainder may be merely named, and the reader can himself suggest typical psychological problems likely to arise in connection with them.

7. *Relation of teacher and pupil.* What social relationships may be encouraged between teacher and pupil? What are the educational effects of distrust, admiration, favoritism? What influences, if any, do such differences between pupil and teacher as those of age, sex, race and social background introduce into the educational situation?

8. *Relation of pupil to objective.* Should the learner be himself conscious of the objective of his training? Which is of central interest, pupil or objective, or can they be distinguished? How should the objective vary with the ability, the prospects, the interests, of the learner? Should the feebleminded and the intellectually gifted have the same educational objective?

9. *Curriculum and objective.* How determine what curriculum is best adapted to the set objective? How can changing objectives be fitted to available materials? To what extent is the setting of an objective determined by the limitations of materials of instruction?

10. *Teacher and curriculum.* Should the teacher determine the curriculum? Should the teacher instead be chosen with the curriculum in mind? Should the teacher be an active contributor to knowledge in the field of his teaching, or only a reservoir of knowledge?

11. *Pupil and curriculum.* Should the pupil be selected in terms of the curriculum, or the curriculum adapted to the character of the pupil? Should the pupil be left wholly free to determine his own curriculum (prescribed or elective plan)? How far should education follow the line of the student's initial interests? Which is first in development, knowledge or interest? Should every boy be taught a trade, or only some; should every pupil study algebra, or only some?

12. *Teacher and objective.* How shall a teacher know when or in how far an objective is attained? How far shall

the teacher determine and be responsible for the educational objective? What type of teacher does each objective require? Should the objective be explicit in the mind of the teacher, or should he merely "execute the curriculum?" Do not objectives often depend on the personality of the teacher?

13. *Pupil and technique.* How shall the technique be adapted to the individual, or should it? Shall adult illiterates be taught to read by the same methods as those used for infants? Is socialized recitation desirable for all students? Should graduates and undergraduates be taught by the same methods? Shall the preference of the pupil determine the technique to be adopted? Are the same techniques appropriate for the instruction of imbeciles, normal pupils, and those exceptionally gifted? Should pupils of equal ability be grouped together for purposes of instruction? What is the effect of such homogeneous grouping on the attitude and on the rate of progress of the individual pupil?

In this way, representative problems or questions might be proposed for the following relationships, each of which is represented by a line in our schematic diagram of the educational situation.

14. Relation of Pupil to Incidental Activities
15. Teacher's Relation to Incidental Activities
16. Incidental Activities as Related to Objective
17. Relation of Incidental Activities to the Curriculum
18. Relation between Technique and Objective
19. Relation of the Teacher to the Technique
20. Technique as Related to Incidental Activities
21. Relationships between Technique and the Curriculum

In addition to these simple relationships, more complex ones may be indicated. Thus, given certain pupils and a certain objective, with curriculum and incidental activities stipulated or determined, what specific problems arise concerning the selection of the teacher and the adaptation of technique? Given a group of blind children, with limited incidental activities, the objective being mastering the standardized curriculum so as to be able to achieve college entrance, what would be the qualifications of the most effective teachers and what the methods to be employed in the project?

To pursue all of these formal topics and analyses and to assemble such information as is available with respect to them would not only be impossible, but it would be dull and tiresome as well. Instead of any such program as this, we use the diagram and our analysis of it merely as a convenient scheme of reference. Enough typical topics have been developed to serve to introduce the reader to the general methods of educational psychology, and to representative sections of its content. With such a background, and with the general analysis at hánd to suggest a method of attack, each individual student of the subject should be enabled to make definite progress in the solution of such psychological problems as may be encountered from day to day in his own educational activities. At least he may be afforded a general notion of just what educational psychology is, and be enabled to see its particular place in the larger program of the science of education.

PROBLEMS

1. Suggest and characterize other "general philosophies" or "objectives" of education, similar to those cited in the chapter.
2. How far back into history do written records of education go? What were some of the earliest educational problems and methods?
3. Suggest some psychological problems that might arise in connection with the teacher's relation to incidental activities of pupils in the elementary school; the high school.
4. Point out instances in which incidental activities have been definitely related to the chief objectives of education.
5. Suggest concrete cases in which techniques that succeed in the hands of one teacher might fail when tried by another.
6. Does your school have any general rules concerning the relation of pupils and incidental activities?

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Consult the list of readings given for Chapter I for further references on the general place of psychology in education.

INDEX OF AUTHORS

Allen, 231
Allport, F. H., 102
Andrews, B. R., 512
Armstrong, H. E., 365
Ayres, L. P., 253, 258, 371, 383, 436, 478

Bagley, W. C., 8, 159, 475, 477, 481
Bair, J. H., 318
Baldwin, B. T., 111, 112
Barlow, M. C., 131
Bathurst, J. E., 493
Bernard, L. L., 102
Betts, H. H., 159
Binet, A., 41
Blanchard, P. M., 475
Bobbitt, F., 450
Bode, B. H., 33
Book, W. F., 188, 202, 203, 211, 294, 296, 301, 304, 306, 317, 318
Boyce, A. C., 486
Briggs, T. H., 383, 429
Bronner, A., 286
Brooks, F. D., 331, 343
Brown, H. E., 366
Brownell, H., 365
Broyler, C. R., 412, 414
Bryan, 188
Bühler, C., 12, 13, 246
Burgess, M. A., 258
Burnham, W. H., 401
Burr, E. T., 272
Burt, C., 250, 264, 273, 382, 384, 472, 474, 475
Buswell, G. T., 330, 343
Butsch, R. L. C., 319

Cabot, F. P., 475
Cabot, R. C., 401
Cameron, H. C., 401
Cannon, W. B., 80
Carmichael, A. M., 469
Carothers, F. E., 176
Carroll, H. A., 418
Cason, H., 102
Cederstrom, J. A., 364
Chapman, J. C., 8, 251, 319
Charters, W. W., 159, 384, 435, 443, 447, 450
Clapp, F. L., 481
Clark, W. W., 467, 468
Cobb, M. V., 122
Coffman, L. D., 480
Cole, R. D., 384
Collings, E., 236
Colvin, S. S., 33, 188
Comenius, 433, 434, 439
Coover, J. E., 429
Counts, G. S., 8, 512
Courtis, S. A., 253
Coxe, W. W., 419
Crabbs, L. M., 491
Crawford, C. C., 211
Cubberley, E. P., 8
Cutler, 319

Davis, W. W., 429
Dearborn, W. F., 264, 343
DeVoss, J. C., 80
Dewey, J., 8, 80, 211, 224, 450, 512
Douglass, H. R., 159, 236, 262
Downing, E. R., 366
Drushel, 231
Dykema, P. W., 384

Ebbinghaus, H., 183
Eldredge, 319
Elliott, E. C., 238, 264, 483
Ellis, R. S., 132
Engelhardt, N. L., 160
Erickson, 207

Fenton, J. C., 14
Filter, R. O., 33
Fracker, G. C., 429
Frank, J. O., 366
Frankfurter, W., 319
Freeland, G. E., 236
Freeman, F. N., 34, 159, 264, 343, 366, 384
Fritz, 319
Furfey, P. H., 475

Galton, F., 393
Garrett, H. E., 243
Gates, A. I., 8, 185, 186, 188, 198, 218, 259, 260, 338, 339, 343, 371, 429
Gates, G. S., 206
Gesell, A., 246
Gilchrist, E. P., 205
Glenn, M., 384
Goddard, H. H., 286
Goodenough, F. L., 250
Gray, H. A., 286
Gray, W. S., 343
Gregory, C. A., 264
Guthrie, E. R., 494, 495

Haefner, R., 319
Haggerty, M. E., 248, 462, 465, 467
Hall, E. H., 366
Hamblen, A. A., 419
Harap, H., 451
Harris, P. E., 475
Harter, 188
Hartshorne, H., 470, 472
Headley, L. A., 211
Heald, 321
Healy, W., 466, 467, 475
Heinetz, W., 319
Held, O. C., 33
Herbart, 219
Hewins, N. P., 429
Hildreth, G. H., 265, 286
Hillegas, M. B., 253, 381, 384
Hockett, J., 444, 445
Hoke, E. R., 294, 311-314, 319
Holley, C. E., 159, 236
Hollingworth, H. L., 34, 58, 80, 109, 120, 132, 133, 173, 174, 180, 188, 252, 262, 264, 268, 286, 319, 343, 401, 453, 475, 482, 497
Hollingworth, L. S., 121, 122, 148, 275, 281, 286, 401, 475
Holt, E. B., 34, 80
Hosic, 232
Hotchkiss, E. A., 236
Hudelson, E., 376, 381, 384
Huey, E. B., 343
Hull, C., 133, 264
Hurd, A. W., 366
Hurlock, E. B., 80, 204

Inskeep, A. D., 286
Irwin, E. A., 8, 286, 462

James, W., 58, 95
Janet, P., 392
Jensen, 378
Jersild, A. T., 189, 191
Johnson, P. Q., 363
Johnson, R. I., 440
Jones, H. E., 182, 183
Jones, J. F., 438
Jordan, A. M., 343
Judd, C. H., 159, 254, 343, 419

Kandel, I., 8
Kefauver, G. N., 133, 214
Keith, J. A. H., 159, 477, 481
Kelly, F. J., 265
Kempf, E. J., 80
Kilpatrick, W. H., 8, 159, 224, 232, 512

King, 207
Kirkpatrick, E. A., 207
Klein, D., 188
Knight, F. B., 486, 493
Koffka, K., 34
Koos, L. V., 133
Kornhauser, A. W., 211
Krackowizer, 232
Kraepelin, E., 253
Kuhlmann, F., 111, 113, 246
Kyte, G. C., 160

Lacy, 207
Ladd, G. T., 188
Lahy, J. M., 319
Lamson, E. E., 282
LaRue, D. W., 236, 401
Leuba, C., 80
Locke, J., 405, 434
Lull, H. L., 160
Lund, F. H., 361

Madden, R., 267
Maller, J. B., 99
Mann, C. R., 366
Marks, L. A., 8, 286, 462
Martin, E. D., 512
Mateer, F., 475
May, M., 470, 472
McAdory, 250, 382, 383
McCall, W. A., 248, 257, 260, 265
McDougall, W., 103
McDowell, E. D., 269
McGeoch, J. A., 183, 184
McMurry, C. A., 366
Mearns, H., 378, 384, 451
Meier, N. C., 250, 382, 383
Meiklejohn, A., 8
Meriam, J. L., 486, 512
Meumann, E., 34
Meyer, M. F., 80
Miller, E., 384
Monroe, P., 8, 433
Monroe, W. S., 80, 159, 236, 443
Moore, 207
Morgan, J. B., 462, 475
Morrison, H. C., 159
Munroe, M., 343
Murphy, G., 401
Mursell, J. L., 384
Myer, 248

Nash, J. B., 475
National Academy of Science Memoirs, 479
National Society for the Study of Education, 265, 281, 283, 285, 286, 338, 366, 451
Norsworthy, N., 120
Norvell, 202, 203

Oakes, M. E., 366
O'Brien, J. A., 343
Ogburn, W. F., 512
Ogden, R. M., 8
Otis, A., 248
Owen, M. B., 319

Parker, S. C., 159, 218
Paterson, 172, 173, 249
Paton, S., 401
Pavlov, I., 425
Pear, T. H., 211
Peckstein, 200
Perrin, F. C., 188
Peterson, J., 131
Phelps, W. L., 159
Pillsbury, W. B., 58
Pintner, R., 133, 172, 173, 174, 248, 249, 265, 489
Plato, 432, 433, 435
Poffenberger, A. T., 103, 407, 426
Pohlmann, 207
Popenoe, H. F., 362
Pressey, L. C., 265, 401
Pressey, S. L., 265, 401
Proctor, W. A., 133
Prosser, 231
Purdom, T. L., 286
Pyle, W. H., 34, 188, 199, 211, 249

Randall, 231
Raup, R. B., 80
Reagan, 80
Reed, H. B., 159, 236, 343, 366, 384
Reisner, E. H., 8, 512
Rice, 253
Rissland, L. Q., 206
Robbins, C. L., 236
Robinson, E. S., 34, 58
Rogers, H. W., 306, 310, 319
Roman, F. W., 512
Ross, J. W., 319
Ruch, G. M., 260, 265, 362, 493
Ruediger, W. C., 236
Ruger, H. A., 188
Rugg, H. O., 430, 444, 445, 482, 483, 512
Russell, B., 513

Sandiford, P., 8
Sayles, M. B., 462, 475
Schutte, T. H., 484, 485
Seashore, C. E., 249, 250, 264, 382, 383, 384
Shumaker, A., 512
Smith, A., 366
Smith, W. A., 343
Snedden, D., 231, 513
Snyder, 199
Sorelle, 319
Spearman, C., 133
Spence, 497
Spencer, H., 434, 435, 439, 450
Starch, D., 8, 188, 192, 194, 238, 264, 338, 381, 424, 429, 430
Stecher, L., 111, 112
Stedman, L. M., 287
Stevenson, J. A., 229, 231, 232
Stimson, 231
Stockton, J. L., 236
Stoddard, G. D., 265
Stone, C. W., 232, 253, 254
Stormzand, M. J., 160, 236
Strayer, G. D., 160, 478
Strong, E. K., 128, 129
Swift, E. J., 319
Symonds, P. M., 265, 497
Tarkington, B., 7
Taylor, W. S., 401
Telford, F., 493
Terman, L. M., 245, 248, 260, 265, 275, 277, 287, 378, 382
Theisen, W. W., 331
Thom, D. A., 475
Thomson, M. K., 103
Thorndike, E. L., 8, 10, 34, 47, 67, 103, 133, 174, 175, 188, 248, 250, 253, 256, 257, 260, 265, 319, 335, 336, 350, 366, 383, 384, 411-415, 430, 479
Thurstone, L. L., 248, 475
Todd, E. M., 439
Trabue, M. R., 248, 265, 381
Trafton, G. H., 366
Trow, W. C., 8
Tsai, L. H., 194
Tuttle, W. W., 319
Twiss, G. R., 346, 366

Uhl, W. L., 441

Van Teslaar, J. S., 402
Vanuxem, M., 272
Van Wagenen, M. J., 265
Van Waters, M., 475

Wade, F. B., 365
Wallin, J. E. W., 287, 402
Washburn, M. F., 58, 80
Washburne, C., 236, 451
Watson, G. B., 497
Watt, H. J., 211
Weaver, E. E., 402
Weber, E., 207
Wells, F. L., 58, 294, 306, 319, 402
Westaway, F. W., 366
Whipple, G. M., 211, 249, 251
White House Conference Publications, 133, 265
Whitley, 183, 184
Whitney, F. L., 183, 184

Wickman, E. K., 459, 460, 462, 464, 475
Wiese, 319
Williams, H. D., 475
Willoughby, R. R., 175
Wilson, G. M., 80, 437
Wilson, H. B., 80, 160
Winch, W. H., 430
Winford, C. A., 148, 286
Winship, A. E., 475
Woodring, M. N., 366
Woodrow, H. H., 129, 130, 287
Woodworth, R. S., 80, 188, 430
Woody, C., 253, 254
Woodyard, E., 412, 414
Worcester, D., 207
Wyatt, H. G., 58, 402

Yerkes, R. M., 247
Yoakum, C. S., 247

Zachry, C., 475

INDEX OF SUBJECTS

Ability, in learning, 175; measurement of, 245; patterns of, 119; special, 249
Accomplishment ratio, 246
Achievement, measurement of, 252; of dull pupils, 271; of gifted pupils, 282; test of, 260
Activities, familiar, 36; measurement of, 240; original, 96; vital, 81
Adaptation, reflexes with, 84; to insecurity, 395
Adjustments, fundamental types of, 96; in human beings, 95; of the whole organism, 84
Administration, of education, 516
Adolescence, 457
Adults, learning of, 173
Affect, and effect, 75
Age, and learning, 171; and misconduct, 462; spirit of, 502
Aim, of education, 3; of science teaching, 349
Alcohol, effect on learning, 180
Alpha Tests, 247
Analysis, method of, 219; of meaning, 333; of mental control, 53; of musical ability, 379; of typing, 294
Animals, behavior of, 83; learning of, 10
Appreciation, 367
Apprehension span, 324
Apprenticeship, 212
Arithmetic, as reasoning, 352; curriculum of, 443; function of, 354; measurement of, 253; psychology of, 346
Arts, of appreciation and expression, 367
Attention, direction of, 196; emphasis by, 358
Attitudes, learning of, 25; objective, 386
Avenue, of stimulation, 206

Background, 141, 243
Balance, mental, 35
Basis, of originality, 56; of prediction, 127
Behavior, of animals, 83; of school children, 452; normal trends in, 453
Belief, and desire, 361
Birth, learning before, 16
Botany, 363

Caffeine, effect of on typing, 307
Career, as motive, 214; of gifted children, 283
Cases, of faulty control, 43
Changes, in development, 108; in education, 498
Character, measurement of, 251
Code learning, 18
College, curriculum of, 447; Entrance Board, 248; students, 176
Common elements, 411
Comparison, of measures, 106
Complexity, of education, 498; of reading, 320
Composition, 376
Concepts, evolution of, 356; of education, 498; of instinct, 85
Conditioning, 424
Conduct, transfer of, 420
Conflict, 197
Context, 50

Contrast, 358
Control, and mental balance, 35; in familiar activities, 36; in the neurotic, 45; lack of, in illusions, 44; in school activities, 49; map for analysis of, 53; mental, 43; of reflexes, 35; of transfer, 417
Coöperation, of drives and incentives, 65
Coöperativeness, 99
Corrective training, 439
Correlation, of traits, 486
Creative expression, 377
Criteria, of misconduct, 460
Cue reduction, in handwriting, 368; in reading, 327; in typing, 296
Cues, and motives in learning, 67; producing transfer, 420; versus motives or drives, 62
Curriculum, in typewriting, 311; methods of formulating, 431; of college, 447; psychology of, 431
Curves, of forgetting, 182; of growth, 113; of learning, 163, 166, 170; of typing, 304; of work, 304

Deceit, studies of, 470
Defects, of speech, 268
Delinquency, 472
Democracy, 500
Denominator, canceling of, 392
Description, of motives, 69
Development, changes in, 108; laws of, 109
Diagnostic tests, 260
Diagram, of learning process, 30
Diminishing returns, 166
Direction, of attention, 196
Disciplinary values, 412
Discovery, and learning, 27, 235
Distress, and emotion, 389; as substitute for instinct, 86; due to thought and sympathy, 93; from insults to self, 91; with social basis, 92
Distribution, of errors in spelling, 149; of learning ability, 177; of practice, 192; of teachers' marks, 238
Disuse, effect of, 181
Docility, and sagacity, 39; intelligence and, 47
Drawing, measurement of, 250; psychology of, 372
Drill, 141, 215
Drives, 62, 65
Dullness, in pupils, 269
Dynamics, of education, 59

Education, administration of, 516; aim of, 3; changes in, 498; dynamics of, 59; effect of on individual differences, 130; experimental nature of, 4; fields of, 5, 514; *foundations of*, 499; *history of*, 516; human motives in, 81; neuroses in, 509; of exceptional pupils, 266; of the dull, 269; of the gifted, 280; philosophy of, 514; special, 266
Effect, and affect, 75; law of, 72; motivation and, 75; of distribution of practice, 192; of disuse, 181; of education, 130; of repetition, 191
Efficiency, of teachers, 487
Elementary years, 454
Emotion, and instinct, 95; as sign of distress, 389; measurement of, 251
Enrichment, of experience, 138
Errors, in spelling, 148
Evolution, of concepts, 356
Examinations, new type, 261
Exceptional pupils, 266
Experiments, on impression, 189; on transfer, 407
Exploration, in reading, 324
Expression, art of, 367; measurement of, 381; motivation in, 374
Extroversion, 94
Eye-voice span, 330

Facilitation, and interference, 52
Factors, in learning, 161
Facts, misrepresentation of, 468
Familiar activities, control in, 36
Faulty control, cases of, 43
Feeble-mindedness, 269
Feelings, learning of, 25; transfer of, 421
Fields, of education, 5
Five formal steps, 220
Flash cards, 218
Forgetting, psychology of, 184
Frontier life, 506

Generalization, 222, 357
Geography, curriculum of, 444; lessons in, 152; teaching of, 149
Gifted pupils, 275
Global learning, 199
Group tests, 246
Grouping, homogeneous, 284
Growth, curves of, 113
Guidance, educational, 124; in typing, 309; of learning, 135; vocational, 124

Habits, new and old, 395; of higher order, 300
Handicaps, sensory and motor, 267
Handwriting, learning of, 368; measures of, 370
Happiness, 391
Health, bodily, 398; mental, 384
Herbartian method, 221
High school, age, 457; courses, 412
History, of education, 516
Homogeneous grouping, 284
Human, engineering, 81; motives in education, 81; psychology, instincts in, 87; urges, dominant, 89

Ideals, cultural, 505
Illusions, 44
Imagery, in typing, 299
Impression, techniques of, 189
Impressiveness, varieties of, 190
Improvement, of reading, 340
Incentives, and drives, 65; versus motives, 62
Indirect adaptation, 84
Individual differences, and education, 130; in learning, 175
Individuals, emphasis of, 503; motives originating in, 64; tests of, 245
Infancy, learning in, 12; prolongation of, 502
Insecurity, 395
Instinct, and emotion, 95; concept of, 85; in human psychology, 87; organic distress as substitute for, 86
Instruction, items of, 135; management of, 189; techniques of, 134, 158
Instructor, function of, 317
Integration, 109
Intelligence, and misconduct, 464; and teaching efficiency, 487; docility and, 47; mental health and, 394; of teachers, 488; tests of, 246
Interests, and curriculum, 441
Interference, and facilitation, 52
Intermediate steps, 148
Interpretation, of results, 410; of scores in tests, 242
Introversion, 94
Inventory, of needs, 438
Irritants, and happiness, 391; as motives, 60
Issues, in education, 520

Job analysis, and spelling, 435
Joint action, 353

Knowledge, and thought, 344; of results, 201

Lack of control, in illusions, 44; in the neurotic, 45

Language, arts of, 367; learning of, 16
Law, of effect, 72, 75
Learner, 104, 147
Learning, as anticipatory, 78; as economizing, 78; as related to age, 171; before birth, 15; curves of, 163; discovery and, 27, 235; general factors of, 161; global and piecemeal, 199; guidance of, 135; in adults, 173; in defectives, 128; individual differences in, 175; in infancy, 12; motives in, 67; of attitudes, 25; of codes, 18; of feelings, 25; of language, 16; of lower animals, 10; of reading, 320; of thoughts, 25; permanence of, 362; process of, 30; scope and variability in, 40; studies of, *162; to drive a motor car, 23;* to play the piano, 21; transfer in, 46, 407
Lessons, in geography, 152
Letters, frequency of, 312
Life career motive, 214
Limits, of practice, 169
Lying, 468

Management, of instruction, 189
Map, of mental control, 53
Maturation, 108, 240, 245
Meaning, analysis of, 333; of reading, 320
Measurement, in arithmetic, 253; in expressive arts, 381; in science teaching, 361; in typewriting, 314; need for, 237; of emotion and character, 251; of general ability, 245; of handwriting, 370; of musical ability, 249, 379; of reading, 255; of school achievement, 252; of single activity, 240; of special ability, 249; of teaching efficiency, 490; problems of, 239
Measures, comparison of, 106
Mental, balance, 35; health, 384, 394; limps, 388; patterns, 120
Methods, in class room, 212; in science teaching, 359; of apprenticeship, 212; of drill, 215; of Herbart, 221; of logical analysis, 219; of project teaching, 228; of purposive problem, 223
Misbehavior, criteria of, 459
Misrepresentation, of facts, 468
Modes, of relief, 94
Modification, of motives, 69
Motion pictures, 207
Motivation, and law of effect, 75; in expressive arts, 374; in science teaching, 360; of learner, 147
Motives, and cues, 67; as irritants, 60; description of, 69; human, 81; in the individual, 64; of life *career, 214; providing effective,* 203; stimuli as, 59; strength of, 98; versus incentives, 62
Motor car, learning to drive, 23
Music, psychology of, 379

Needs, for measurement, 237; inventory of, 438
Neuroses, in education, 509
Neurotic, control in the, 45

Objective, of science teaching, 345
Omnibus tests, 260
Organic distress, 86
Organism, adjustments of, 84; quality of, 104
Original activities, 96
Originality, 56
Over-learning, 185

Pace, of development, 111
Patterns, mental, 120; of ability, 119
Performance tests, 248
Phenomena, of transfer, 46

Philosophy, of education, 514
Physical education, 439
Piano, learning to play, 21
Piece-meal learning, 199
Plateaus in learning, 168
Population, of school, 476, 507
Practice, curves of, 163; distribution of, 192; limits of, 169
Prediction, basis of, 127
Preparation, 222
Problem method, 223
Problems of measurement, 239
Process, of learning, 30
Program, of reading, 341
Project method, 228, 232, 234
Psychographs, 114
Psychology, and the curriculum, 431; dynamic, 504; instincts in, 87; of arithmetic, 346; of drawing, 372; of forgetting, 184; of learning, 9; of methods, 212; of music, 379; of projects, 232; of purpose, 71; of purposive problem, 227; of reading, 325; of school subjects, 288; of teaching, 137; of the teacher, 476
Pupils, behavior of, 452; experience of, 138; population of, 476; psychographs of, 114
Purpose, and method, 223; psychology of, 13, 71
Purposive problem, 223
Pyramid, educational, 579

Quality, of organism, 104

Rating scales, 482
Reading, and thinking, 335; as visual exploration, 323; complexity of, 320; cue reduction in, 327; for understanding, 331; improvement of, 340; interests in, 441; learning of, 320; meaning of, 320; measurement of, 255; oral, 325; program of, 341; teaching of, 336; tests of, 255
Reality, facing of, 387
Reasoning, in arithmetic, 352; in reading, 335
Recitation, advantages of, 198
Reflexes, 83; control of, 35; in animals, 83; with indirect adaptation, 84
Relief, modes of, 94
Repetition, effect of, 191
Repression, 391
Results, knowledge of, 201

Sagacity, docility and, 39; intelligence and, 47; or scope, 353
Scales, 243, 482
School conduct, and intelligence, 464; as related to age and sex, 462
School, population, 476, 507; subjects, 142, 288
Science, measurement in, 361; teaching of, 344
Scientific inquiry, 499
Scope, in arithmetic, 353; in reading, 330; variability in, 40
Self, appraisal of, 386; insults to, 91
Sex, and misconduct, 462
Significance, 334
Skepticism, value of, 393
Skill, sensori-motor, 291
Social surveys, 444
Sorrows, of unguided pupil, 292
Speech, defects of, 268
Spelling, and job analysis, 435; errors in, 148; graphic, 144; oral, 145
Stability, of education, 508
Standards, 241
Stanford Achievement Test, 260
Stimulation, avenue of, 206
Stimuli, as motives, 59
Strength, of motives, 98
Student opinion, of teachers, 494
Studies, of deceit, 470; of gifted pupils, 276; of learning, 162; of typewriting curriculum, 311

Stuttering, 269
Substitution test, 18
Superstitions, concerning gifted children, 279
Symbols, 209, 348
Sympathy, as basis of distress, 93

Teacher, and criteria of behavior, 460; economic background of, 479; efficiency of, 487; intelligence of, 488; psychology of, 476; rating scales of, 482; responsibility of for transfer, 418; student opinion of, 494; trade tests for, 492; traits of, 480
Teaching, measures of, 490; methods of, 212; of geography, 149; of reading, 336; of science, 344; projects in, 228; psychology of, 137
Techniques, of impression, 189; of instruction, 134, 158
Tests, of intelligence, 246; of school achievement, 260
Thinking, and reading, 335
Thought, controls by, 360; outcomes of, 344; transfer of, 421
Thoughts, distress due to, 93; learning of, 25
Time, lapse of, 181, 501
Trade tests, for teachers, 492
Transfer, amount of, 416; and formal discipline, 405; control of, 417; cues producing, 420; experiments on, 407; history of, 405; incompleteness of, 424; in learning, 46; of thought, feeling and conduct, 421
Trends, in behavior, 453
Truancy, 467
Typing, learning of, 291; measurement of, 314

Urges, dominant, 89

Variability, in learning and scope, 40
Variations, in learning, 179; of project method, 231
Varying concomitants, 358
Vital activities, 81
Vocational guidance, 124, 309

Walking alone, 397
Work, and mental health 399; curves of, 304
World changes, 501

Zoölogy, 364

(4)